SELECTED WATER RESOURCES ABSTRACTS

VOLUME 3, NUMBER 16
AUGUST 15, 1970

W70-06315 -- W70-06731

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SELECTED
WATER RESOURCES ABSTRACTS

A Semimonthly Publication of the Water Resources Scientific Information Center,
Office of Water Resources Research, U.S. Department of the Interior

VOLUME 3, NUMBER 16
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Use of funds for printing this publication approved by the Director of the Bureau of the Budget, September 4, 1968.

As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States—now and in the future.

FOREWORD

Selected Water Resources Abstracts, a semimonthly journal, includes abstracts of current and earlier pertinent monographs, journal articles, reports, and other publication formats. The contents of these documents cover the water-related aspects of the life, physical, and social sciences as well as related engineering and legal aspects of the characteristics, conservation, control, use, or management of water. Each abstract includes a full bibliographical citation and a set of descriptors or identifers which are listed in the **Water Resources Thesaurus** (November 1966 edition). Each abstract entry is classified into ten fields and sixty groups similar to the water resources research categories established by the Committee on Water Resources Research of the Federal Council for Science and Technology.

Sufficient bibliographic information is given to enable readers to order the desired documents from local libraries or other sources. WRSIC is not presently prepared to furnish loan or retention copies of the publications announced.

Selected Water Resources Abstracts is designed to serve the scientific and technical information needs of scientists, engineers, and managers as one of several planned services of the Water Resources Scientific Information Center (WRSIC). The Center was established by the Secretary of the Interior and has been designated by the Federal Council for Science and Technology to serve the water resources community by improving the communication of water-related research results. The Center is pursuing this objective by coordinating and supplementing the existing scientific and technical information activities associated with active research and investigation program in water resources.

To provide WRSIC with input, selected organizations with active water resources research programs are supported as "centers of competence" responsible for selecting, abstracting, and indexing from the current and earlier pertinent literature in specified subject areas. Centers, and their subject coverage, now in operation are:

- Ground and surface water hydrology at the Water Resources Division of the U.S. Geological Survey, U.S. Department of the Interior.
- Metropolitan water resources management at the Center for Urban Studies of the University of Chicago.

- Eastern United States water law at the College of Law of the University of Florida.
- Policy models of water resources systems at the Department of Water Resources Engineering of Cornell University.
- Water resources economics at the Water Resources Research Institute of Rutgers University.
- Design and construction of hydraulic structures; weather modification; and evaporation control at the Bureau of Reclamation, Denver, Colorado.
- Eutrophication at the Water Resources Center of the University of Wisconsin, jointly sponsored by the FWPCA, Soap and Detergent Association, and the Agricultural Research Service.
- Water resources of arid lands at the Office of Arid Lands Studies of the University of Arizona.

In cooperation with the Federal Water Pollution Control Administration, the following "centers of competence" have been established:

- Thermal pollution at the Department of Sanitary and Water Resources Engineering of Vanderbilt University.
- Textile wastes pollution at the School of Textiles of North Carolina State University.
- Water quality requirements for freshwater and marine organisms at the College of Fisheries of the University of Washington.
- Wastewater treatment and management at the Center for Research in Water Resources of the University of Texas.

The input from these Centers, and from the 51 Water Resources Research Institutes administered under the Water Resources Research Act of 1964, as well as input from the grantees and contractors of the Office of Water Resources Research and other Federal water resources agencies with which the Center has agreements becomes the information base from which this journal is, and other information services will be, derived; these services include bibliographies, specialized indexes, literature searches, and state-of-the-art reviews.

Comments and suggestions concerning the contents and arrangement of this bulletin are welcome.

Water Resources Scientific
Information Center
Office of Water Resources Research
U.S. Department of the Interior
Washington, D. C. 20240

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ABSTRACT SOURCES

SELECTED WATER RESOURCES ABSTRACTS

01. NATURE OF WATER

1A. Properties

THE STRUCTURE OF WATER,
Ambassador Coll., Pasadena, Calif. Dept. of Chemistry.
S. R. Erlander.
Science Journal, Vol 5A, No 5, p 60-65, November 1969. 6 p, 4 fig, 5 ref.

Descriptors: *Water structure, *Hydrogen bonding, *Ions, Molecular structure, Polarity, Water properties, Water chemistry, Freezing, Melting, Ice.
Identifiers: Water polymers.

Recent research in the structure of water is briefly reviewed. The topics discussed are normal water structure, ice structure, water polymers, ion-water relations, biological aspects of water structure, solubility of hydrocarbons, hydration, high pressure water structures, and thermodynamics of water. (Knapp-USGS)
W70-06537

1B. Aqueous Solutions and Suspensions

FURTHER STUDIES OF PROPERTIES OF SEA WATER AND ITS CONCENTRATES TO 200 DEG C,
California Univ., Berkeley.
For primary bibliographic entry see Field 03A.
W70-06331

02. WATER CYCLE

2A. General

INFLUENCE OF TIDAL INLETS ON SALINITY AND RELATED PHENOMENA IN ESTUARIES,
Texas Univ., Austin. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02L.
W70-06315

FLUVIAL PHYSIOGRAPHY AS A FACTOR IN BASIN RESPONSE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Mastafa Elmas Ulugur.
PhD dissertation, Colorado State University, Fort Collins, June 1969. 155 p, 31 fig, 18 tab, 126 ref, 4 append.

Descriptors: *Rainfall-runoff relationships, *Runoff forecasting, *Routing, *Rational formula, Drainage, Equations, Peak discharge, Runoff coefficient, Watersheds (Basins), Mathematical studies, Flood routing, Hydraulics, Hydrography, Topography.
Identifiers: Radiality coefficient, Drainage efficiency.

The effect of the fluvial physiography on basin response was studied and two new fluvial parameters were defined. The first of the new parameters is the radiality of the tributaries within the basin. It is a measure of flood synchronization from various tributaries. For a semicircular basin with an outlet at the center, the radiality is 1.00. For differenct values of radiality, routing shows that the flood hydrographs from tributaries shift when radiality is low. When radiality is high, they become a family of hydrographs very close to each other. The second of the new parameters is the drainage efficiency index that expresses whether the channel flow or overland flow is dominant. The increase in the drainage efficiency index increases peak discharge in two ways: (1) by decreasing the time of concentration; (2) by increasing the total valume of runoff. A new formula for flood prediction from intermediate-sized basins is introduced to replace the older rational formula. The new formula contains all the parameters appearing in rational formula including the slope and newly defined fluvial parameters. (Knapp-USGS)
W70-06345

HYDROLOGY OF A SMALL RURAL WATERSHED UNDER SUBURBAN DEVELOPMENT - PHASE I,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Kurt Nathan, George H. Nieswand, and Anthony J. Esser.
Available from the Clearinghouse as PB-191 715, $3.00 in paper copy, $0.65 in microfiche. Completion Report, New Jersey Water Resources Research Institute, Rutgers University, March 1970. 86 p, 34 fig, 15 ref. OWRR Project A-009-NJ (3).

Descriptors: *Small watershed, *Rainfall-runoff relationships, Basins, Hydrographs, Runoff, Storm runoff, Surface runoff, Time lag, Time of concentration, Unit hydrographs.
Identifiers: Suburban hydrology, Hydrologic change.

A small rural watershed in New Jersey is being studied for changes in hydrological characteristics during suburban development. Two stream gaging stations and two recording precipitation gages have been established in the area. During Phase I, covered in this report, regression models for the hydrological properties have been derived for the undeveloped basin. A standard unit hydrograph has also been established for this period. Monitoring of water quality has been initiated recently. The study will be continued during Phase II and III, during and after development. (Nathan-Rutgers)
W70-06447

DYANMIC HYDROLOGY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
Peter S. Eagleson.
New York, McGraw-Hill, Inc, 1970. 462 p, 170 fig, 36 tab, 305 ref, 4 append.

Descriptors: *Hydrology, *Hydrologic cycle, *Rainfall-runoff relationships, *Streamflow, *Mathematical models, Water balance, Hydrologic budget, Fluid mechanics, Hydrodynamics, Groundwater movement, Infiltration, Soil water, Climatology, Synoptic analysis, Surface-groundwater relationships, Energy budget, Runoff, Overland flow, Snowmelt, Evaporation, Transpiration, Evapotranspiration, Lakes, Oceans, Atmosphere, Solar radiation, Thermodynamics.
Identifiers: *Dynamic hydrology, Textbook.

The principal physical processes of interest to engineering hydrologists are summarized in a textbook intended for use by professionals and advanced students who have at least some basic knowledge of fluid mechanics. Where possible, processes are analyzed using mathematical models which satisfy 1, physical validity, using the essential concepts of fluid dynamics and thermodynamics, confirmed by observation; and 2, simplicity, to encourage and facilitate the use of models. The topics discussed include: history of hydrology; the hydrologic cycle; transport processes in the atmosphere and oceans; composition of the atmosphere; composition of the oceans and lakes; energy balance of the Earth; planetary fluid dynamics; atmospheric circulation; general circulation of the oceans; climatic variability; precipitation; evaporation and transpiration; snowmelt; infiltration and groundwater flow; surface runoff and streamflow; and catchment morphology and rainfall-runoff relationships. Appendices give units of measure, constants, solar attitude, and solutions to the one-dimensional diffusion equation. (Knapp-USGS)
W70-06522

ESTIMATION OF MAXIMUM FLOODS.

World Meteorological Organization Technical Note No 98 (WMO-No 233.TP.126), Geneva, Switzerland, 1969. 288 p, 60 fig, 24 tab, 128 ref.

Descriptors: *Flood forecasting, *Frequency analysis, Routing, Hydrograph analysis, Analytical techniques, Maximum probable flood, Regional flood, River forecasting, Rainfall-runoff relationships, Flood protection, Flood control, Hydrology, Snowmelt, Meteorology, Statistical methods, Probability.
Identifiers: World Meteorological Organization.

Information is presented on methods of evaluation of meteorological conditions for estimation of maximum floods. Methods are given for estimating the extremes of rainfall and snowmelt on the basis of physical analysis, and for converting these into estimates of extreme flood flows. Statistical methods and their application to storm and flood events are discussed. Statistical analysis and techniques used in various countries in flood frequency analysis are outlined. The use of meteorological data in estimating flood frequencies is described. (Knapp-USGS)
W70-06535

SUMMARY REPORT STORMS OF 1969,
Los Angeles County Flood Control District, Calif.
Larry D. Simpson.
Los Angeles County Flood Control District Summary Report, June 1969. 55 p, 30 photo, 1 plate, 3 tab.

Descriptors: *Floods, *California, *Flood control, *Reservoirs, Peak discharge, Storm runoff, Urbanization, Flood protection, Channel improvement, Flood damage, Streamflow, Rainfall-runoff relationships, Stage-discharge relations.
Identifiers: Los Angeles County (Calif), Debris basins.

Data on flood-producing storms of 1969 in Los Angeles County, California, are tabulated. During the months of January and February of 1969, storms occurred over the southern California area which were of such a magnitude as to tax the capacities of a number of the facilities of the district and to cause significant damage to public and private property in those areas where complete flood protection had not yet been attained. These storms began with a two-phase storm which occurred between January 18 and 26, 1969, inclusive, followed by a storm which occurred between February 23 and 25, 1969. The effects of these storms on the Los Angeles County Flood Control District and the communities within Los Angeles County are discussed. (Knapp-USGS)
W70-06542

AVAILABILITY OF RAINFALL-RUNOFF DATA FOR PARTLY SEWERED URBAN DRAINAGE CATCHMENTS,
American Society of Civil Engineers, New York.
L. S. Tucker.
Available from the Clearinghouse as PB-191 755, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 13, Urban Water Resources Research Program, March 1970. 156 p, 24 fig, 15 tab, 49 ref. append. OWRR Project C-1536 (No 1992) (3).

Descriptors: *Data collections, *Rainfall-runoff relationships, *Cities, *Storm runoff, *Stream gages, Sewers, Open channels, Urbanization, Hydrologic data, Runoff, Drainage systems, Storm drains.
Identifiers: Japan, Urban runoff.

Available rainfall-runoff data for partially sewered urban drainage catchments are identified to facilitate model development by researchers. Information on the availability of rainfall-runoff data from 64 developed partially sewered urban drainage catchments in U.S. and 8 in Japan is summarized. The 64 catchments in the U.S. are concentrated in 8 states, and the locations of these in-

strumented catchments are shown by a map. Rainfall-runoff data for most of the catchments are available from the agencies collecting the data. A summary of information on the 64 instrumented, highly-developed, partially sewered urban drainage catchments in the U.S. is presented. Additional details such as availability of data, how to obtain further information about catchments and data, gage locations and maps of catchments are presented. (Knapp-USGS)
W70-06573

A STUDY OF THE HYDROLOGY AND GEOLOGY OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
For primary bibliographic entry see Field 02F.
W70-06705

2B. Precipitation

NON-METROPOLITAN DENSE RAINGAGE NETWORKS,
American Society of Civil Engineers, New York.
L. S. Tucker.
Available from the Clearinghouse as PB-191 709, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 11, Urban Water Resources Research Program, January 1970. 51 p, 15 fig, 8 tab, 19 ref. OWRR Project C-1536, Contract 14-01-0001-1992.

Descriptors: *Rain gages, *Networks, Rainfall-runoff relationships, Urbanization, Hydrology, Data collections, Hydrologic data, Instrumentation, Gaging stations.
Identifiers: Urban hydrology.

Information on 13 dense recording rain gage networks located in nonmetropolitan areas of the United States is summarized. The 13 networks are located in 8 states. Data reduced and recorded on punch cards or magnetic tape for most of the networks. Rainfall data for all networks are available, although arrangements for obtaining data will vary considerably with the source and inquiries should be made to the organizations involved. Only 6 of 13 networks are still in operation. Locations of 15 of the 20 largest U.S. cities operating rain gages are shown on a map. Information on the 13 dense rain gage networks is tabulated. (Knapp-USGS)
W70-06317

REGIONAL DISCRIMINATION OF CHANGE IN RUNOFF,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-06346

TRITIUM CONCENTRATION IN PRECIPITATION, 1967-1968,
Southwestern Radiological Health Lab., Las Vegas, Nev.; and Southeastern Radiological Health Lab., Montgomery, Ala.
For primary bibliographic entry see Field 05B.
W70-06515

URBAN ENERGY BALANCE CLIMATOLOGY,
California Univ., Los Angeles. Dept. of Geography.
Werner H. Terjung.
The Geographical Review, Vol 60, No 1, p 31-53, January 1970. 23 p, 16 fig, 23 ref.

Descriptors: *Climatology, *Cities, *Energy budget, *Heat balance, Heat budget, Albedo, Evaporation, Environment, Humidity, Meteorology, California, Precipitation (Atmospheric), Air temperature, Urbanization, Roads, Topography, Ecology.
Identifiers: Urban climatology, Los Angeles (Calif).

A pilot study of urban energy balance climatology covered only a part of a large city, Los Angeles, to test the feasibility of a large-scale approach in which traditional parameters were observed. An attempt was made to record some of the energy-balance components of the city and the human interface. A remote sensing mission by NASA covered part of the area. According to aerial photographs the largest percentage of the area was in concrete or concrete-like materials (including many roofs). The second major surface cover was light-colored blacktop. The observed parameters appear to have distinct patterns in relation to the downtown business district, the industrial-commercial zone and freeways, and the residential areas. A 'net radiation island' was caused by the shadow effect of tall buildings, which caused low surface and terrain temperatures. Residential areas exhibited higher net radiation than the industrial zone but less than the business district. Parking areas had large differences between air temperature and actual surface temperature. Net radiation was disposed of mainly as sensible heat flux (about 80%) and heat flux into the ground (about 20%). Low air temperatures and low values of the net radiation of the human interface generally did not coincide. (Knapp-USGS)
W70-06516

ESTIMATION OF MAXIMUM FLOODS.
For primary bibliographic entry see Field 02A.
W70-06535

PROJECT SKYWATER,
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.
For primary bibliographic entry see Field 03B.
W70-06678

PROJECT SKYWATER, 1969 ANNUAL REPORT.
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.
For primary bibliographic entry see Field 03B.
W70-06703

2C. Snow, Ice, and Frost

FINAL REPORT ON INVESTIGATION OF DESALINATION BY FREEZING,
Westinghouse Research Labs., Pittsburgh, Pa.
For primary bibliographic entry see Field 03A.
W70-06335

SWAMP VEGETATION-AN INDICATOR FOR NON-FROZEN AREAS IN THE NORTHERN TAIGA OF WESTERN SIBERIA,
A. P. Tyrmikov.
Available from Clearinghouse as AD-692 523. U.S. Army Foreign Science and Technology Center Technical Translation HT-23-741-68, 1968. 10 p, 7 tab, 8 ref. Translation of Akad, Nauk sssr, 1963, p 62-71.

Descriptors: *Swamps, *Vegetation effects, *Tundra, *Terrain analysis, Freezing, Thawing, Frozen ground, Permafrost, Arctic, Cold regions, Frozen soils, Subarctic, Topography, Aquatic environment, Marshes, Surface waters.
Identifiers: Taiga, Swamp vegetation, USSR.

In the northern taiga of Western Siberia, swamp vegetation can be used to determine the location of frozen and non-frozen areas. The type of vegetation is determined by: (1) the presence or absence of water on the surface of swamps; (2) the presence or absence a permanently-frozen layer of soil. Surface water in the swamps is a critical factor in thaw, freeze, and temperature of the soil. A number of factors cause variations in the depth and time of thawing and freezing, keeping the swamps in a state of change. Changes in water levels cause variation in the amount of surface water, the depth of thaw and freeze, and the vegetation. (Knapp-USGS)
W70-06396

ORIGIN AND ENVIRONMENTAL SIGNIFICANCE OF LARGE-SCALE PATTERNED GROUND, DONNELLY DOME AREA, ALASKA,
Cold Regions Research and Engineering Lab., Hanover, N.H.
Richard E. Church, Troy L. Pewe, and Marvin J. Andresen.
Available from the Clearinghouse as AD-474 477, $3.00 in paper copy, $0.65 in microfiche. Research Report 159, June 1965. 78 p, 34 fig, 18 ref.

Descriptors: *Permafrost, Tundra, *Alaska, *Frozen ground, Climatology, Structural geology, *Silts, Sediments, Arctic, Melting, Stratigraphy.
Identifiers: Donnelly Dome Area (Alas), Polygons.

Large-scale patterned ground in the Donnelly Dome are of central Alaska consists of polygons 25 to 46 m in diameter bounded by shallow troughs 1 to 2 m wide that form the sides of the polygons. The troughs are underlain by wedge-shaped masses of sediments that extend downward 2 to 3 m. Texture of the sediments of the wedges is distinct from that of the poorly stratified glacial outwash gravel that the wedges transect. Sediments of the wedge vary texturally along the strike and vertically within a given wedge. The coarsest material in the wedge is about 75 mm in diameter, which is the same size as the coarsest material in the outwash. The fine material in the wedges is silt, the same as that which blankets the area. The patterned ground of the Donnelly Dome area originated during Wisconsin time when the mean annual air temperature was at least 3C colder than now. With the warming of the climate in post-Wisconsin time most of the perennially frozen gravel thawed and the ice wedges melted. The voids created by the melting of the ice wedges were filled with sediment that was washed from the surface or collapsed from the thawed sides of the voids. The troughs bounding the polygons are now, however, no longer underlain with ice wedges but with ice wedge pseudomorphs (fossil ice wedges). (Author)
W70-06454

STRENGTH DATA ON LAKE ICE,
Army Cold Regions Research and Engineering Lab., Hanover, N.H.
Guenther E. Grankenstein.
Available from the Clearinghouse as PB-163 661, $3.00 in paper copy, $0.65 in microfiche. Technical rept. 80 SIPRE-022.02.033, Jan. 61, 23 p. 5 fig, 5 tab, 2 ref.

Descriptors: *Ice, *Iced lakes, *Snow, *Strength, Solar radiation, Test procedures, Michigan.
Identifiers: Portage Lake, Chassel Bay, Keweenaw Bay, Lake Superior.

Results are reported of 245 in-place supported beam tests and 56 in-place cantilever beam tests conducted during the 1957-58 winter on clear ice and a combination of clear and snow-ice from Chassel and Keweenaw Bays (Mich.). The supported beams had a higher computed flexural strength than similar cantilever beams. The flexural strength of the supported beams with the surface layer in tension was always higher than the supported beams with the bottom layer in tension. As reported earlier, the flexural strength of cantilever beam tests was highest when the bottom layer was in tension. On a clear day with air and ice temperatures near 0C, ice strength will decrease by as much as 6 times from morning to mid-aft. The testing equipment is illustrated, summary data are tabulated and graphed, and results of individual tests are appended.
W70-06455

VARIATION OF SOME MECHANICAL PROPERTIES OF POLAR SNOW, CAMP CENTURY, GREENLAND,
Army Cold Regions Research and Engineering Lab., Hanover, N.H.
Austin Kovacs, W. F. Weeks, and Frank Michitti.

CRREL Research, Rept no. CRREL-RR-276, Hanover, N.H. Dec. 69, 35 p.

Descriptors: *Snow surveys.
Identifiers: *Snow density, Snow mechanical properties, Camp Century, Greenland *Snow strength test.

The present study analyzes the results of a large number of measurements of the unconfined compressive strength of polar snow from Camp Century, Greenland, where it was possible to obtain samples with densities varying over essentially the complete natural density range for polar snow and ice. The loading apparatus used was designed specifically for the purpose. The variations of the static Young's modulus and the ring-tensile strength of the snow and ice were also studied.
W70-06464

2D. Evaporation and Transpiration

EFFECT OF IRRIGATION FREQUENCY ON THE AVERAGE EVAPOTRANSPIRATION FOR VARIOUS CROP-CLIMATE-SOIL SYSTEMS,
Utah State Univ., Logan.
A. L. Norero, J. Keller, and G. Ashcroft.
Pap No 69-723, 1969 Winter Meet, Amer Soc Agr Eng, Chicago, Ill, Dec 1969. 21 p, 6 fig, 1 tab, 23 ref.

Descriptors: Irrigation, *Irrigation practices, *Evapotranspiration, Soil moisture, Consumptive use, Soil-water-plant relationships, Soil water, Effects, *Crops, Time, Bibliographies, Corn (Field), Alfalfa, Lysimeters, Climates, Curves, Climatic data.
Identifiers: Potential evapotranspiration.

A formula was developed and tested describing the relationship between evapotranspiration and soil moisture as affected by irrigation frequency, taking into account various effects of the interacting crop-climate-soil systems. Examples are given and the final development of curves was produced from field crop data found in literature. Data selected were for corn grown in shallow field lysimeters and deep rooted field alfalfa to demonstrate rather extreme cases in terms of the irrigation frequency required for maintaining a relative productivity. The usefulness of these curves for designing irrigation systems and developing irrigation scheduling practices was discussed. (USBR)
W70-06380

SOIL WATER EVAPORATION, ISOTHERMAL DIFFUSION, AND HEAT AND WATER TRANSFER,
Iowa State Univ., Ames.
For primary bibliographic entry see Field 02G.
W70-06523

2E. Streamflow and Runoff

HYDROLOGICAL REGIONS IN SCANDINAVIA AND FINLAND,
Swedish Meteorological and Hydrological Inst., Stockholm. Hydrological Div.
Ragnar Melin.
Nordic Hydrology, Vol 1, No 1, p 5-37, 1970. 33 p, 12 fig, 7 tab, 21 ref.

Descriptors: *Regional analysis, *Streamflow, *Regime, *Rainfall-runoff relationships, Discharge (Water), Hydrologic data, Regions, Topography, Climates, Precipitation (Atmospheric), Statistical methods.
Identifiers: *Scandinavia, *Finland.

The rivers of Scandinavia and Finland are studied with regard to regime, regional distribution, and long-term variations in discharge. The regime studies are based on monthly mean coefficients, that is the relation between the monthly means and the average annual discharge for a 30-year period. Within the two main areas of nival highland and lowland regime and Atlantic snow and rain regime, different local regime types were studied. The regional distribution was estimated with correlation coefficients and relations between means for one year expressed as a percentage of the mean discharge of 1931-60. The variations of 30- and 10-year mean discharge were studied by the method of moving averages from the year 1901. (Knapp-USGS)
W70-06326

FLOOD PLAIN INFORMATION OF CUMBERLAND RIVER, POOR, CLOVER, AND MARTINS FORKS, AND CATRON CREEK, HARLAN, KENTUCKY.
Army Corps of Engineers, Nashville, Tenn.
For primary bibliographic entry see Field 04A.
W70-06328

USE OF DIGITAL COMPUTERS IN PROCESSING, PUBLISHING, AND ANALYZING HYDROLOGIC DATA,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 07C.
W70-06329

EVALUATION OF THE SURFACE-WATER DATA PROGRAM IN KANSAS,
Geological Survey, Lawrence, Kans. Water Resources Div.
For primary bibliographic entry see Field 07A.
W70-06330

APPLICATION OF RUN-LENGTHS TO HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
J. Saldarriaga, and V. Yevjevich.
Colorado State University Hydrology Paper No 40, April 1970. 56 p, 29 fig, 10 tab, 31 ref, append. NSF Grants GK-11444 and G-11564.

Descriptors: *Drought, *Probability, *Precipitation (Atomospheric), *Time series analysis, Stochastic processes, Discharge (Water), Runoff forecasting, Statistical methods, Regression analysis, Statistical models, Streamflow forecasting.
Identifiers: Theory of runs.

A method was developed for investigating time series structure by using the mean run-length parameter. This method is distribution free. Applications to selected annual precipitation series and annual runoff series demonstrate its feasibility. Analytical expressions were developed by which the probabilities of sequences of wet and dry years of specified lengths can be calculated when the basic hydrologic time series is either an independent or a dependent stationary series of a variable which follows the first-order linear autoregressive model. Numerical values of probabilities of run-lengths may be obtained by the digital computer integration of expansion equations for run-length probabilities of the first-order linear autoregressive model. A set of tables and a set of graphs are presented to make the numerical values readily usable. Probabilities of run-lengths of dependent variables with a common distribution are also distribution free. This method and several applications are based on the premise that run-lengths, as statistical properties of time series, represent useful parameters in studying droughts and surpluses. (Knapp-USGS)
W70-06332

SIMILARITY IN UNLINED IRRIGATION CANAL SYSTEMS,
Southampton Univ. (England). DEPT. OF Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-06333

FLUVIAL PHYSIOGRAPHY AS A FACTOR IN BASIN RESPONSE,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-06345

REGIONAL DISCRIMINATION OF CHANGE IN RUNOFF,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Viboon Nimmannit, and Hubert J. Morel-Seytoux.
Colorado State University Hydrology Paper No 37, November 1969. 40 p, 12 fig, 65 tab, 39 ref. USBR Contract No BR-14-06-D-6597.

Descriptors: *Runoff forecasting, *Weather modification, Water supply, Statistical methods, Streamflow forecasting, Colorado River basin, Water resources development, River basin development.
Identifiers: Precipitation management, San Juan Mountains (Colo).

Appropriate statistical tests for regional target-control techniques of evaluation is a suitable method for reduction of an originally large number of variables, and a choice between the Upper Basin of the Colorado River or the San Juan Mountains as a more suitable area of precipitation management operations were studied. The T-squared test is appropriate for multiple target-control techniques of evaluation. Canonical analysis is suitable for the reduction of a large number of original variables. The Upper Basin of the Colorado River is preferable under the assumption of an equal percentage of increase in runoff. However, if the percentage increase in the southern area is at least 1.2 times as large as in the northern area (and recent publications suggest that this ratio is probably around 3) then the southern area is preferable. The minimum number of years for detecting an increase of 10 percent in spring runoff was calculated to be 3 years in the Upper Basin of the Colorado River, and 4 years in the San Juan Mountains. (Knapp-USGS)
W70-06346

FLOOD HAZARD INFORMATION, SANTA CRUZ RIVER, SANTA CRUZ COUNTY, ARIZONA.
Corps of Engineers, Los Angeles, Calif.
For primary bibliographic entry see Field 04A.
W70-06347

FLOOD PLAIN INFORMATION, ANAHOLA, KAUAI, HAWAII.
Corps of Engineers, Honolulu, Hawaii.
For primary bibliographic entry see Field 04A.
W70-06348

COMPILATION OF HYDROLOGIC DATA, ELM FORK TRINITY RIVER, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.

Geological Survey Open-file report, 1969. 54 p, 2 fig, 6 tab, append.

Descriptors: *Small watersheds, *Rainfall-runoff relationships, *Data collections, *Hydrologic data, *Texas, Streamflow, Stage-discharge relations, Storm runoff, Flood control, Floods, Stream gages, Gaging stations, Flow characteristics, Low flow, Peak discharge, Hydrographs, Mass curves, Duration curves.
Identifiers: *Elm Fork Trinity River (Tex).

Rainfall and runoff data were collected during the 1967 water year for the 46.0-square-mile area above the stream-gaging station Elm Fork Trinity River near Muenster, Texas. The location of floodwater-retarding structures and hydrologic instruments in the area are shown on maps. Data are to be used to determine the net effect of floodwater-retarding structures on the regimen of streamflow

at downstream points; to determine the effect of the structures on the sediment yield of the basin and to determine the trap efficiency of the structures; to develop computation techniques that will provide more accurate estimates of runoff resulting from a given amount of rainfall on small watersheds; and to develop relationships between maximum rates of runoff and rainfall in small watersheds that will enable more accurate design of small storm-drainage structures. (Knapp-USGS)
W70-06350

FLOODS IN HAMPSHIRE QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Oak Park, Ill.
For primary bibliographic entry see Field 06F.
W70-06351

DETERMINATION OF THE MANNING COEFFICIENT FROM MEASURED BED ROUGHNESS IN NATURAL CHANNELS,
Geological Survey, Menlo Park, Calif.
J. T. Limerinos.
Geological Survey Open-file Report, June 1969. 79 p, 9 fig, 5 tab, 28 ref.

Descriptors: *Mannings equation, *Open channel flow, *Alluvial channels, *California, *Rouginess (Hydraulic), On-site investigations, Particle size, Bottom sediments, Gravels, Statistical methods, Mathematical studies.
Identifiers: Bed roughness (Hydraulic).

The hypothesis that basic values of the Manning roughness coefficient of stream channels may be related to (1) some characteristic size of the streambed particles and (2) the distribution of particle size was tested by field determination of stream characteristics. The investigation was confined to channels with coarse bed material to avoid the complication of bed-form roughness in channels composed of fine bed material. Fifty current-meter measurements of discharge and appropriate field surveys were made at 11 sites on California streams for the purpose of computing the roughness coefficient, n, by the Manning formula. The test sites were selected to give a wide range in average size of bed material, and the discharges and surveys were made at such times as to provide data covering a suitable range in stream depth. The relations best fitting the field data were obtained by using either a characteristic particle diameter equal to the 84-percentile size or a diameter obtained by weighting three characteristic particle sizes. (Knapp-USGS)
W70-06352

HYDROLOGIC RECONNAISSANCE OF DEEP CREEK VALLEY, TOOELE AND JUAB COUNTIES, UTAH, AND ELKO AND WHITE PINE COUNTIES, NEVADA,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02F.
W70-06355

STUDY ON THE LONGITUDINAL PROFILE OF RIVER BED (JAPANESE),
Public Works Research Inst., Tokyo (Japan).
For primary bibliographic entry see Field 02J.
W70-06356

FLOOD PLAIN INFORMATION, NORTH BRANCH BIG TIMBER CREEK, CAMDEN COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 4A.
W70-06359

HYDROLOGIC RECONNAISSANCE OF RUSH VALLEY, TOOELE COUNTY, UTAH,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02F.
W70-06364

HYDROLOGIC RECONNAISSANCE OF CURLEW VALLEY, UTAH AND IDAHO,
Geological Survey, Salt Lake City, Utah.
For primary bibliographic entry see Field 02F.
W70-06365

FLOOD HYDROLOGY OF SMALL WATERSHEDS: EVALUATION OF TIME PARAMETERS AND DETERMINATION OF PEAK DISCHARGE,
Hawaii Univ., Honolulu.
I-pai Wu.
Trans Amer Soc Agr Eng, Vol 12, No 5, p 655-663, Sept-Oct 1969. 7 p, 14 ref, 2 tab, 19 ref.

Descriptors: *Peak discharge, *Small watersheds, *Watersheds (Basins), Hawaii, Time, Time lag, *Hydrographs, Recession curves, Hydrologic data, Hydrology, *Rainfall-runoff relationships, Flood hydrographs, Rainfall, Infiltration, Bibliographies.
Identifiers: *Flood hydrology, Instantaneous unit hydrogra, Oahu, Hawaii, *Peak runoff, Linearity.

Results are reported of the evaluation of time parameters and determination of peak discharge for more than 250 flood hydrographs from about 30 small Hawaiian watersheds. The typical characteristics of these watersheds are small size, steep slope, and high infiltration. The relationship between peak discharge and runoff is linear for a given watershed regardless of intensity, duraton, and size of the storm. The time to peak varies slightly from different hydrographs, but will not change the general shape of the hydrograph or the linearity of the peak discharge and runoff relation. Two hydrograph time parameters, time to peak and recession constant, are small and of nearly the same magnitude. Watershed area is the most significant factor in estimating the recession constant and is the dominant factor in determining flood-peak discharge. A simple, instantaneous unit hydrograph is applicable because flood hydrographs are produced by short-duration, high-intensity storms having the characteristic of linear storage of recession flow. A simple, peak-flow equation was derived, based on streamflow records with areas ranging from 0.2 to 10 sq mi. (USBR)
W70-06371

TURBULENCE IN THE MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
For primary bibliographic entry see Field 08B.
W70-06382

SOME CHARACTERISTICS OF MACRO-TURBULENCE IN FLOW PAST A NORMAL WALL,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-06383

THE TURBULENT STRUCTURE OF OPEN RESTRICTED DEPTH FLOW WITH INTERFACE,
Akademiya Nauk URSR, Kiev.
For primary bibliographic entry see Field 08B.
W70-06384

A COMPUTATIONAL INVESTIGATION OF IMPULSIVELY-GENERATED EDDIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
For primary bibliographic entry see Field 08B.
W70-06386

MACRO-TURBULENCE MEASUREMENTS IN NATURAL STREAMS,
Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics
Vladimir Jezdinsky, Jan Cakrt, Miroslav Rudis, and Rados Smutek.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B38, p 323-332, 1967. 10 p, 8 fig, 16 ref.

Descriptors: *Turbulence, *Open channel flow, *Streamflow, *Vortices, *Eddies, Turbulent flow, Instrumentation, Flowmeters, Flow measurement, Hydraulics, Current meters, Water measurement.
Identifiers: *Macroturbulence, Turbulence meters.

A device for measuring macroturbulence in natural streams is described and the results of its use are discussed. The device is based on the principle of combined Prandtl's and yaw tubes connected with two sensitive differential pressure transducers of capacitive type with a thin rubber diaphragm as a detecting element. The instrument measures fluctuating absolute values and vertical deviations of the velocity vector. Those quantities are recorded by a two-channel tape-recorder and, evaluated as longitudinal and lateral velocity-component fluctuations, give arbitrary statistical characteristics, especially turbulent intensities of both velocity components and their integral time-scales. These characteristics are presented as functions of the relative depth. (Knapp-USGS)
W70-06387

LARGE EDDIES IN STRATIFIED FLOW,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
For primary bibliographic entry see Field 08B.
W70-06394

APPLICATION OF COMPUTER TECHNIQUES TO SEEPAGE-SALINITY SURVEYS IN KANSAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 07C.
W70-06508

QUANTITY AND QUALITY OF LOW FLOW IN THE PECOS RIVER BELOW GIRVIN, TEXAS, FEBRUARY 6-9, 1968,
Geological Survey, Austin, Tex.
V. L. Spiers, and H. R. Hejl, Jr.
Texas Water Development Board Report 107, February 1970. 14 p, 2 fig, 3 tab, 3 ref.

Descriptors: *Low flow, *Discharge (Water), *Water quality, *Texas, Chlorides, Solutes, Streamflow, Data collections, Hydrologic data.
Identifiers: *Pecos River (Tex).

During the period February 6-9, 1968, water discharge in the Pecos River increased from 25.9 cfs (cubic feet per second) near Girvin, Texas to 134 cfs near the mouth. The discharge measurements show four major gains, three major losses, and numerous smaller gains and losses between individual sites. The quality of water improved progressively downstream, with dissolved solids decreasing from 15,600 mg/l (milligrams per liter) to 1,720 mg/l. The chloride concentration decreased from 6,480 mg/l to 650 mg/l. (Knapp-USGS)
W70-06511

WATER-LOSS STUDIES OF LAKE CORPUS CHRISTI, NUECES RIVER BASIN, TEXAS, 1949-65,
Geological Survey, Austin, Tex.
C. R. Gilbert.
Texas Water Development Board Report 104, January 1970. 11 p, 3 fig, 1 tab, 4 ref.

Descriptors: *Reservoirs, *Texas, *Bank storage, *Surface-groundwater relationships, Recharge, Aquifers, Sands, Streamflow, Water loss, Water storage.
Identifiers: Lake Corpus Christi (Tex), Nueces River (Tex).

In April 1958 Lake Corpus Christi, which drains 16,656 square miles and is in south-central Texas on the Nueces River, was enlarged. This enlarge-

ment increased the elevation of the conservation pool by 20 feet and increased the potential inundated area by almost 30 sq mi (old lake surface area was about 9 sq mi). A cursory analysis of records of inflow to, change of contents in, and outflow from the lake after 1958 showed large losses of surface water in the reach studied. Past analyses of overbank flooding on the Nueces River much farther upstream have shown large water losses to the wide flood plain. The unaccounted for surface-water loss during 1958, most all of which occurred after April, was computed to be 193,200 acre-ft. In the period April 1958 to December 1961 an unaccounted for surface-water loss of 360,000 acre-ft was computed. For the entire period of study after impoundment, April 1958 to September 1965, a surface-water loss of 497,000 acre-ft was computed. Intermittent water levels were obtained by the Texas Water Development Board at 4 groundwater wells near the lake from September 1956 to March 1965. The 4 wells were located 300, 500, 4,000, and 6,200 feet from the shoreline of the newly formed reservoir. All the wells were screened in the Goliad Sand. During the period 1958-61, the average rise in water level in the 4 wells was about 17 ft. This groundwater gain compares closely with the computed surface-water loss of 360,000 acre-ft for the same period. A general recession of the lake level began in late 1961 and continued until May 1963. The 4 groundwater wells also reflected this general recession. (Knapp-USGS)
W70-06512

RESEARCH ON SLEEPERS RIVER AT DANVILLE, VERMONT,
Agricultural Research Service, Plainfield, Vt.
For primary bibliographic entry see Field 04D.
W70-06519

WATER RESOURCES IN THE BIG LOST RIVER BASIN, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, Idaho.
For primary bibliographic entry see Field 03B.
W70-06529

FLOODS OF APRIL-MAY 1969 IN UPPER MIDWESTERN UNITED STATES,
Geological Survey, St. Paul, Minn.
David B. Anderson, and Harlan H. Schwob.
Geological Survey Open-file report, February 1970. 555 p, 61 fig, 11 tab, 7 ref.

Descriptors: *Floods, *Mississippi River basin, *Snowmelt, North Dakota, South Dakota, Minnesota, Wisconsin, Iowa, Illinois, Snowpacks, Profiles, Streamflow, Stage-discharge relations, Sediment load, Meteorology, Frequency analysis, Discharge (Water), Data collections, Hydrologic data.
Identifiers: Upper Midwest (USA).

The 1969 spring floods in upper Midwestern United States can be attributed primarily to an exceptionally heavy blanket of snow. March precipitation was light, but at the end of the month water content of snow on the ground was as much as 8 inches in some parts of the area. Flood data are presented for 285 gaging sites in this report. Peak stages and discharges exceeded previous known maxima in the upstream tributaries of the Red River of the North, upper Minnesota River basin, upper basin of West Fork Des Moines River, and the James, Vermillion, and Big Sioux River basins. Recurrence intervals exceeded 50 years for 71 of the 178 sites for which recurrence intervals were computed. Aerial photography during the flood was obtained in a number of river basins. Flood damages were estimated to be about $147 million. More than a million acres of rich agricultural land were inundated, and thousands of culverts and bridges were washed out. (Knapp-USGS)
W70-06530

EXTENT AND FREQUENCY OF FLOODS IN THE BEDEN BROOK BASIN IN SOMERSET AND MERCER COUNTIES, NEW JERSEY,
Geological Survey, Trenton, N.J.
Thomas G. Ross.
Geological Survey Open-file report, June 1969. 51 p, 21 fig, 2 plate, 5 tab, 17 ref.

Descriptors: *Floods, *New Jersey, Frequency analysis, Cross-sections, Profiles, Hydrographs, Hydrologic data, Data collections, Stage-discharge relations, Streamflow, Flood protection, Zoning
Identifiers: Beden Brook (NJ).

Data are presented on the areal extent, depth, and frequency of flooding in the Beden Brook basin, New Jersey and are intended to provide the basic data needed for the optimum use and most economic development of the flood plain. Proper use of the data in these reports will aid planning and zoning boards, engineers, architects, and land owners in promoting flood-plain land uses that are compatible with the flood risks involved. (Knapp-USGS)
W70-06533

ESTIMATION OF MAXIMUM FLOODS.
For primary bibliographic entry see Field 02A.
W70-06535

FLOODS IN OHIO, MAGNITUDE AND FREQUENCY, A SUPPLEMENT TO BULLETIN 32,
Geological Survey, Columbus, Ohio.
William P. Cross, and Ronald I. Mayo.
Ohio Department Natural Resources, Division of Water Bulletin 43, April 1969. 230 p, 5 plate, 3 tab, 2 ref.

Descriptors: *Floods, *Frequency analysis, *Ohio, Streamflow, Flood forecasting, Stream gages, Data collections, Hydrologic data, Stage-discharge relations, Discharge measurement.
Identifiers: Flood frequency.

Flood-frequency curves were drawn for all stations in Ohio having more than 15 years of record. The required length of record was reduced to 10 yr for small-area stations (less than 30 sq mi), and the curves for the shorter records were adjusted to the 1921-65 base period by comparison with nearby long-term records. The adjusted mean annual floods were used in the regional analysis for determining floods on ungaged areas. The magnitudes of the 20- and 50-yr recurrence interval floods for each station were reduced to a ratio by dividing by the mean annual flood. This ratio is seen to be larger for small-area streams than for large-area streams, and this relationship applies to all Ohio flood records. The years of record collected since 1956 did not appreciably change the shapes of the 1956 frequency plots. The plots generally are close to a straight line on Gumbel frequency paper, but some deviate either above or below a straight line introducing uncertainties in extrapolation beyond the period of record. (Knapp-USGS)
W70-06536

SUMMARY REPORT STORMS OF 1969,
Los Angeles County Flood Control District, Calif.
For primary bibliographic entry see Field 02A.
W70-06542

ELECTRONIC COMPUTATION OF WATER LEVELS IN RIVERS DURING HIGH DISCHARGES.
Netherlands Rijkswaterstaat, The Hague.

Rijkswaterstaat Communications No 9, The Netherlands, 1969. 28 p, 7 fig, 8 photo.

Descriptors: *Stage-discharge relations, *Deltas, *Mathematical studies, *Channel morphology, Flood forecasting, Flood protection, Routing, Digital computers, Equations, Chezy equation, Weirs, Flood plains.
Identifiers: *Netherlands, Rhine River.

Digital computer methods are discussed for determining stage-discharge relations as modified by natural and manmade changes in channel morphology. The methods are used primarily to calculate flood risk changes in new hydrological projects and for flood protection works design. (Knapp-USGS)
W70-06546

HYDROLOGICAL ATLAS OF CANADA.
National Research Council of Canada, Ottawa (Ontario).
For primary bibliographic entry see Field 07C.
W70-06547

WATER RESOURCES DEVELOPMENT IN MONGOLIA.
Economic Commission for Asia and the Far East (UN), New York.

Water Resources Journal, United Nations Economic Commission for Asia and the Far East (ECAFE), p 1-24, September 1969. 24 p, 7 fig, 11 tab.

Descriptors: *Water resources development, *Planning, *Groundwater, *Surface waters, Arid lands, . Water supply, Water yield, Reservoirs, Water wells, Water utilization, Irrigation, Municipal water, Hydroelectric power.
Identifiers: *Mongolia.

The present state of water resources development in Mongolia is reviewed and plans for future development are outlined. Mongolia is located in an arid zone. The average annual precipitation varies from around 40 mm in the southern part of the country to 400 mm in the northern part. The amount varies considerably from year to year, especially in the north. In spite of the fact that Mongolia on the whole receives little precipitation, heavy rainfall sometimes occurs during the warm season. The mean annual river discharge varies from 0.1 to 1.0 liter/sec/sq km in plateau and desert areas and from 20 to 60 liter/sec/sq km in mountain areas. The runoff coefficient is low, varying from 1 to 50%. The groundwater potential is considerable, amounting to about half the total surface runoff. Groundwater exists at varying depths as perched and artesian aquifers as well as unconfined aquifers. (Knapp-USGS)
W70-06548

GEOLOGY AND GROUNDWATER RESOURCES OF THE MORGANTON AREA, NORTH CAROLINA,
Geological Survey, Raleigh, N.C.
For primary bibliographic entry see Field 02F.
W70-06575

WATER RESOURCES OF WISCONSIN, ROCK-FOX RIVER BASIN,
Geological Survey, Washington, D.C.
R. D. Cotter, R. D. Hutchinson, E. L. Skinner, and D. A. Wentz.
Geological Survey Hydrologic Investigations Atlas HA-360, 4 sheets, 1969. Text, 19 fig, 4 chart, 3 tab, 25 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Wisconsin, Water supply, Water yield, Aquifers, Streamflow, Water quality, Water wells, Water levels, Hydrologic budget, Lakes, Streams, Water utilization.
Identifiers: Rock-Fox River basin (Wis).

The physical environment, availability, distribution, characteristics, movement, quality, water problems, and use of water within the Rock-Fox River basin, Wisconsin are described in order to aid in planning future water management within the basin. General information is given on the basin, derived from data obtained from Federal, State, and local agencies. In addition, new data were col-

lected from areas where available data were scarce. The RockaFox River basin covers about 4,750 square miles in the southeastern part of the State. Large amounts of good quality water are available in the Rock-Fox River basin. Of the 31.4 inches of average annual precipitation that falls on the basin, about 6.6 inches or 1,500 mgd runs off as streamflow. Groundwater is available from 4 aquifers in the basin: the sandstone aquifer, the Platteville-Galena aquifer, the Niagara aquifer, and the sand and gravel aquifer. Any of these aquifers is capable of yielding domestic and stock supplies. The sandstone aquifer commonly yields over 1,000 gpm to wells, as does the sand and gravel in the lower Rock River valley. Both ground- and surface water have high natural hardness; high iron content is a local problem in groundwater. Some lakes and reaches of streams are polluted by industrial, municipal, or domestic wastes, rendering them less useful as wildlife habitat and for recreational purposes. Two potential problems are flooding and pollution of the artesiam system. Data are presented in maps scaled 1:1 million, block diagrams, cross sections, graphs, charts, tables, and text. (Knapp-USGS)
W70-06577

A NOTE ON THE STEADY TWO-DIMENSIONAL FLOW OF A STRATIFIED FLUID OVER AN OBSTACLE,
Melbourne Univ., Parkeville (Australia). Dept. of Mathematics.
For primary bibliographic entry see Field 08B.
W70-06647

ON STRATIFIED FLOWS OVER BOTTOM TOPOGRAPHY,
Harvard Univ., Cambridge, Mass.
S. J. Jacobs.
Journal of Marine Research, Vol 22, No 2, 1964, p 223-235, 5 fig, 8 ref.

Descriptors: *Stratified flow, *Streambeds, Thermal stratification, Fluid mechanics, Flow.

A rotating stratified fluid was bounded above by a horizontal plane and below by bottom topography in the form of a long ridge on a horizontal plane. Far upstream of the topography, the flow in the main body of the fluid is uniform and barotropic and is directed at right angles to the depth contours. The equations of motion are transformed so that temperature appears as an independent variable. For flow over a ridge of small topographic height, it is shown that the lee waves are of negligibly small amplitude when the Rossby number is small. If the terms giving rise to these waves are neglected, the governing equations in (x, y, T) coordinates are linear and can be used to study the flow over finite amplitude topography. A strong component of flow along the ridge is found irrespective of the degree of stratification. Stratification increases this component near the bottom of the fluid on the lee side of the ridge and decreases it on the upstream side. Topographic effects are not confined to a region near the bottom and are felt throughout the entire depth of the fluid. (Guerrero-Vanderbilt)
W70-06649

2F. Groundwater

GROUND-WATER CONDITIONS DURING 1968, VANDENBERG AIR FORCE BASE AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04B.
W70-06321

HYDROLOGY OF HUNGRY HORSE RESERVOIR, NORTHWESTERN MONTANA,
Geological Survey, Menlo Park, Calif.
W. D. Simons, and M. I. Rorabaugh.
Geological Survey Open-file Report, January 1970. 114 p, 29 fig, 40 tab, 9 ref.

Descriptors: *Reservoir operation, *Bank storage, *Surface-groundwater relationships, *Montana, Base flow, Groundwater movement, Water levels, Water utilization, Low flow, Data collections, Hydrologic data, Hydrogeology.
Identifiers: Hungry Horse Reservoir (Mont).

Thr existence of usable bank storage was established by a comptehensive water-budget analysis of Hungry Horse Reservoir for the period, October 1964 through April 1967. A theoretical model of the response of the aquifer adjacent to Hungry Horse Reservoir to changes in reservoir stage was developed. The constants used in the mathematical equations were based on the residuals from the water-budget computations. Computed groundwater storage in the alluvium adjacent to Hungry Horse Reservoir is 108,000 cfs-days between the elevations of 3,336 and 3,560 feet above mean sea level. This amount of added storage is not totally available as reservoir inflow under normal patterns of regulation because of the time lag and hysteresis-loop effects of groundwater movement across the interface between the aquifer and the reservoir. The amounts of groundwater inflow average about 60% of the corresponding groundwater storage. (Knapp-USGS)
W70-06323

GEOLOGY AND GROUNDWATER RESOURCES OF GRAND FORKS COUNTY, NORTH DAKOTA, PART 3-GROUNDWATER RESOURCES,
Geological Survey, Bismarck, N. Dak.
T. E. Kelly, and Q. F. Paulson.
North Dakota Geological Survey Bulletin 53 and North Dakota State Water Comm County Groundwater Studies 13, 1970. 58 p, 16 fig, 1 plate, 2 tab, 50 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *North Dakota, Water wells, Glacial drift, Sands, Gravels, Water yield, Transmissivity, Water quality, Water supply, Water levels, Data collections, Hydrologic data.
Identifiers: Grand Forks County (N Dak).

Groundwater is obtainable in Grand Forks County, North Dakota from the bedrock and from the overlying glacial drift deposits. Sustained yields of as much as 500 gallons per minute have been pumped from the Dakota Group in eastern Grand Forks County. Water from the bedrock aquifers generally is very saline. Five major aquifers in the glacial deposits were delineated by test drilling. The Elk Valley aquifer covers at least 200 square miles, and yields greater than 500 gpm are obtainable locally. The Inkster aquifer is small but contains water of excellent quality. Regional groundwater movement is eastward, and eastern Grand Forks County is part of a large artesian discharge area. Geochemical data indicate a progressive water quality change eastward across the county from a low-salinity calcium bicarbonate type to a high-salinity sodium sulfate chloride type. (Knapp-USGS)
W70-06337

GEOLOGY FOR PLANNING IN DE KALB COUNTY, ILLINOIS,
Illinois State Geological Survey, Urbana.
David L. Gross.
Illinois Geological Survey Environmental Geology Note No 33, April 1970. 26 p, 6 fig, 16 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Illinois, Water yield, Water quality, Sands, Gravels, Glacial drift, Sandstones, Dolomite.
Identifiers: De Kalb County (Ill).

The mineral and water resources of De Kalb County, Illinois are summarized in a report for use in planning the future growth of the county. Groundwater is available in De Kalb County for most purposes, including municipal, industrial, domestic, and livestock uses. Groundwater availability is controlled by the distribution, thickness, and character of the geologic units present in the county. The principal aquifers are sand and gravel in the unconsolidated deposits and fractured limestone or dolomite and permeable sandstone in the bedrock. Sand and gravel aquifers in De Kalb County are widely distributed, both areally and vertically, throughout the county, but in several areas they are absent or too thin. Sand and gravel occur principally in the glacial meltwater channels which lie along present drainageways or are buried under younger glacial deposits. Many domestic and farm wells obtain water from dolomites in parts of the northern, central, and southeastern parts of the county where the drift cover is thicker. Where sandstones occur directly below fairly thick, extensive sand and gravel deposits, they may supply a considerable amount of vertical recharge. This is a highly favorable situation for the development of large groundwater supplies. (Knapp-USGS)
W70-06338

AVAILABILITY OF WATER FOR ARTIFICIAL RECHARGE, PLAINS GROUNDWATER MANAGEMENT DISTRICT, COLORADO,
Geological Survey, Denver, Col.
For primary bibliographic entry see Field 04B.
W70-06339

GEOLOGY AND GROUNDWATER RESOURCES OF WELLS COUNTY, NORTH DAKOTA: PART III - GROUNDWATER RESOURCES,
Geological Survey, Bismarck, N. Dak.
Frank Buturla, Jr.
North Dakota Geological Survey Bull 51 and North Dakota State Water Comm County Groundwater Studies 12, 1970. 57 p, 18 fig, 2 plate, 1 tab, 35 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *North Dakota, Water wells, Glacial drift, Sands, Gravels, Water yield, Transmissivity, Water quality, Water supply, Water levels, Data collections, Hydrologic data.
Identifiers: *Wells County (N Dak).

The residents of Wells County, North Dakota obtain most of their water from aquifers in the glacial drift and underlying Cretaceous rocks. Aquifers in the glacial drift have the greatest potential for large groundwater withdrawals. Sand and gravel deposits underlie surficial outwash plains and channels, and are found in buried valleys. Nine major drift aquifers were mapped and described. Yields in excess of 500 gallons per minute are possible from the New Rockford aquifer, a buried valley fill. Yields of as much as 500 gpm are obtainable in places from the Manfred and Heimdal aquifers, and as much as 250 gpm in other aquifers. In most parts of the county, some groundwater also is available from Cretaceous rocks underlying the drift. Water from the glacial drift aquifers is generally very hard, but only moderately saline. Most is suitable for domestic and livestock use and also for irrigation use with good drainage. Water from the Cretaceous rocks generally is soft, but rather saline. It is generally unsuitable for irrigation. (Knapp-USGS)
W70-06340

GEOLOGY AND RELATED GROUNDWATER OCCURRENCE, SOUTHEASTERN MASON COUNTY, WASHINGTON,
Department of Water Resources, Olympia, Washington.
Dee Molenaar, and John B. Noble.
Washington Department of Water Resources Water-Supply Bulletin No 29, 1970. 145 p, 8 fig, 2 plate, 5 tab, 16 ref.

Descriptors: *Water resources, *Groundwater, *Aquifers, *Washington, Glacial drift, Sands, Gravels, Water wells, Water yield, Transmissivity, Water quality, Water supply, Water levels, Data collections, Hydrologic data.
Identifiers: Mason County (Wash).

The northwestern part of Mason County, Washington lies in the Olympic Mountains and the remainder lies in the Puget Sound lowland. The groundwater supplying most of the water needs in the lowland area is obtained principally from the coarser phases of Salmon Springs Drift, Skokomish Gravel, and Vashon Drift. The older undifferentiated sedimentary deposits locally provide large yields to deep industrial and municipal wells. The annual precipitation at Shelton averages 64 inches. Most of the rainfall occurs from October to May, and the summers are relatively dry. Water levels in wells are generally within 50 feet of land surface. Well yields range from less than 10 gpm to more than 4,000 gpm. Present groundwater use is principally for domestic and public supply. The groundwater is generally of good chemical quality. Only 4 wells are known to have yielded water with a hardness of greater than 180 mg/l. Three wells yield water with chloride content of greater than 300 mg/l; this amount of chloride resulted from salt-water encroachment from nearby marine waters. As much as 1.6 mg/l of iron is present in groundwater locally, although the average iron content of sampled waters is 0.14 mg/l. (Knapp-USGS)
W70-06341

RESULTS OF WATER-RESOURCES INVESTIGATIONS THROUGH 1968 IN YELLOWSTONE NATIONAL PARK, WYOMING,
Geological Survey, Cheyenne, Wyo.
Edward R. Cox.
Geological Survey Open-file report, September 1969. 87 p, 8 fig, 10 tab, 1 ref.

Descriptors: *Water supply, *Groundwater, *National Parks, *Wyoming, Water wells, Aquifers, Surveys, Investigations, Camp sites, Hydrogeology, Data collections, Hydrologic data.
Identifiers: *Yellowstone National Park.

Water supply investigations in Yellowstone National Park, begun in September 1966, include the study of water problems at selected sites and an overall appraisal of water resources in the Park. Reconnaissance studies were made near selected sites. Test holes were augered; wells were constructed and their yield characteristics determined by pumping tests. Fountain Paint Pot, Tower Junction, Slough Creek campground, South Entrance, Mud Volcano, and Norris Junction have potential groundwater supplies. It seems doubtful that groundwater can be obtained to replace surface-water supplies now in use at Canyon Village and Mammoth. The overall quality of water for use at Mammoth would not be improved by changing the point of diversion from Glen Creek to Lava Creek. Most water sampled to date is potable. Fluoride concentrations of groundwater and surface water at places, however, exceed the recommended limit established by the U.S. Public Health Service. (Knapp-USGS)
W70-06354

HYDROLOGIC RECONNAISSANCE OF DEEP CREEK VALLEY, TOOELE AND JUAB COUNTIES, UTAH, AND ELKO AND WHITE PINE COUNTIES, NEVADA,
Geological Survey, Salt Lake City, Utah.
J. W. Hood, and K. M. Waddell.
Utah Department of Natural Resources Technical Publication No 24, 1969. 54 p, 8 fig, 1 plate, 16 tab, 51 ref, append.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Utah, *Nevada, Arid lands, Water wells, Water levels, Aquifers, Springs, Hydrogeology, Data collections, Hydrologic data, Water quality, Water resources development, Safe yield, Water yield.
Identifiers: Deep Creek Valley (Utah-Nev).

Deep Creek Valley is a 281,000-acre north-trending depression on the Utah-Nevada State line. The known groundwater reservoir in the valley is in unconsolidated rocks, and underlies at least 32,000 acres. Nearly half of the 290,000 acre-ft of annual precipitation falls on the lowlands below an altitude of about 6,500 ft, and does little more than sustain soil moisture. Most runoff and recharge is derived from precipitation above 6,500 ft. The estimated average annual runoff from the uplands is 28,000 acre-ft. The estimated annual outflow from the valley, including some discharge from springs and seepage areas, is 2,000 acre-ft, or about 0.7% of the estimated volume of average annual precipitation in the drainage basin. The estimated average annual recharge to and discharge from the groundwater reservoir is 17,000 acre-ft. The amount of groundwater available for salvage from nonbeneficial discharge in Deep Creek Valley is estimated to be about 4,000 acre-ft. If 100 ft of saturated deposits in the groundwater reservoir were dewatered, the estimated volume of water that could be recovered would be 320,000 acre-ft. The range in the concentration of dissolved solids is 38-562 mg/l. Because existing stream and spring supplies appear to be fully appropriated, future additional development would have to depend on water from wells. (Knapp-USGS)
W70-06355

VARIATIONS IN THE CHEMICAL QUALITY OF GROUNDWATER BENEATH AN IRRIGATED FIELD, CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 02K.
W70-06358

THE YORK COUNTY GROUNDWATER WITHDRAWAL INVESTIGATION, 1968,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
For primary bibliographic entry see Field 04B.
W70-06360

WATER WELLS AND SPRINGS IN PANAMINT, SEARLES, AND KNOB VALLEYS, SAN BERNADINO AND INYO COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 04B.
W70-06363

HYDROLOGIC RECONNAISSANCE OF RUSH VALLEY, TOOELE COUNTY, UTAH,
Geological Survey, Salt Lake City, Utah.
J. W. Hood, Don Price, and K. M. Waddell.
Utah Department of Natural Resources Technical Publication No 23, 1969. 63 p, 7 fig, 1 plate, 17 tab, 44 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Utah, Arid lands, Water wells, Water levels, Aquifers, Springs, Hydrogeology, Data collections, Hydrologic data, Water quality, Water resources development, Safe yield, Water yield.
Identifiers: Rush Valley (Utah).

Rush Valley, Utah is an elongated depression that covers about 250,000 acres and is part of a drainage basin that covers about 470,000 acres. The source of all water in Rush Valley is the 550,000 acre-feet of precipitation that falls mainly on the Oquirrh, Stansbury, Onaqui, and Sheeprock Mountains. The extimated maximum potential long-term average annual runoff from the uplands is 70,000 acre-ft of water. No surface water leaves the topographically closed valley. The estimated average annual groundwater recharge to and discharge from Rush Valley is in the range of 34,000-37,000 acre ft. Groundwater is discharged from the valley by wells, by evapotranspiration (including spring flow), and by subsurface outflow through the east edge of the valley. In 1966, wells discharged about 4,800 acre-ft of water. Evapotranspiration accounts for about 70% of the total groundwater discharge, and subsurface outflow accounts for about 14%. The estimated perennial yield of groundwater in Rush Valley is about 15,000 acre-ft. If water levels were lowered 100 ft, the estimated amount of recoverable water would be 1.6 million acre-ft. The range of concentrations of dissolved solids in water in the drainage basin is 200-2,180 ppm. The main use of the water has been for irrigation. In 1966, an estimated 5,800 acres were irrigated partly with surface water and supplemental groundwater and partly with groundwater alone. Groundwater is the main source of water for future development in the valley. (Knapp-USGS)
W70-06364

HYDROLOGIC RECONNAISSANCE OF CURLEW VALLEY, UTAH AND IDAHO,
Geological Survey, Salt Lake City, Utah.
E. L. Bolke, and Don Price.
Utah Department of Natural Resources Technical Publication No 25, 1969. 40 p, 4 fig, 2 plate, 6 tab, 27 ref.

Descriptors: *Water resources, *Groundwater, *Utah, Idaho, Water quality, Water yield, Water supply, Aquifers, Alluvium, Saline water, Water wells, Data collection, Hydrologic data, Hydrogeology.
Identifiers: Curlew Valley (Utah-Idaho).

The Curlew Valley drainage basin which extends across the Utah-Idaho State line lies between latitude 41 deg 40 min and 42 deg 30 min north and longitude 112 deg 30 min and 113 deg 20 min west, and covers about 1,200 sq mi. The valley is bounded on the west, north, and east by mountain ranges having peaks ranging from about 6,500 to nearly 10,000 ft above mean sea level, and is open to the south where it drains into Great Salt Lake. It is an arid to semiarid, largely uninhabited area, with community centers at Snowville and Kelton. Average annual precipitation is less than 8 inches on part of the valley floor and reaches a maximum that exceeds 35 inches on one of the highest mountain peaks. Confined aquifers in alluvial and lacustrine deposits and intercalated volcanic rocks in the valley fill yield several hundred to several thousand gallons of water per minute to individual large-diameter irrigation wells west of Snowville and near Kelton. Most of the groundwater in the western part of the subbasin is of suitable chemical quality for domestic supply and irrigation; some of the water in the eastern part is not of suitable chemical quality for these uses. Most of the water throughout the valley is suitable for stock use. A slight increase in the dissolved-solids content of the water withdrawn from wells near Snowville during recent years suggests that pumping has induced the upward movement of highly mineralized water from a deeper to a more shallow aquifer. Thus the ultimate quantity of groundwater may depend on the chemical quality of the groundwater. (Knapp-USGS)
W70-06365

GROUNDWATER RESEARCH IN THE U.S.A.,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 06B.
W70-06402

MILLERS RIVER BASIN, MASSACHUSETTS BASIC-DATA REPORT NO.11-GROUNDWATER SERIES,
Geological Survey, Boston, Mass.
For primary bibliographic entry see Field 04B.
W70-06405

A GEOPHYSICAL STUDY OF ALLUVIAL VALLEYS IN WESTERN MORA COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
Jerry W. Mercer, and Eric G. Lappala.
Geological Survey Open-file report, February 1970. 69 p, 34 fig, 1 tab, 4 ref.

Descriptors: *Seismic studies, *Groundwater, *Water levels, *Alluvium, *New Mexico, Surveys, Investigations, Water resources, Water yield, Aquifers, Water wells, Geophysics.
Identifiers: Seismic refraction studies.

The seismic-refraction method of geophysical prospecting was used in western Mora County to determine the saturated thickness of alluvial deposits in the valley of the Mora River and its tributaries. Seismic data indicate a maximum thickness of alluvial deposits of over 300 feet and a minimum thickness of less than 3 feet. Depths to the top of the saturated zone range from 0 to over 10 feet. (Knapp-USGS)
W70-06507

WATER-LOSS STUDIES OF LAKE CORPUS CHRISTI, NUECES RIVER BASIN, TEXAS, 1949-65,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-06512

WATER SUPPLY WELL SRC-2, STALLION RANGE CENTER, WHITE SANDS MISSILE RANGE, SOCORRO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
For primary bibliographic entry see Field 04B.
W70-06513

GEOHYDROLOGY - PROJECT RULISON, GARFIELD COUNTY, COLORADO,
Geological Survey, Denver, Colo.
For primary bibliographic entry see Field 08H.
W70-06517

HYDROLOGIC SITUATION NORTH OF SNIPES MOUNTAIN NEAR SUNNYSIDE, YAKIMA COUNTY, WASHINGTON,
Geological Survey, Tacoma, Wash.
For primary bibliographic entry see Field 04B.
W70-06518

GEOHYDROLOGY OF THE CROSS-FLORIDA BARGE CANAL AREA WITH SPECIAL REFERENCE TO THE OCALA VICINITY,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04A.
W70-06534

GENERAL HYDROLOGY OF THE MIDDLE GULF AREA, FLORIDA,
Geological Survey, Tallahassee, Fla.
R. N. Cherry, J. W. Stewart, and J. A. Mann.
Geological Survey Open-file Report, 1969. 168 p, 45 fig, 4 tab, 34 ref.

Descriptors: *Hydrogeology, *Water resources, *Florida, Hydrologic budget, Groundwater, Surface waters, Springs, Groundwater movement, Streamflow, Aquifers, Water supply, Water utilization.
Identifiers: Middle Gulf Area (Fla).

The Middle Gulf area in the west-central coast of peninsular Florida encompasses about 1,700 sq mi. The area is drained principally by the Crystal, Homosassa, Chassahowitzka, Weekiwachee, Pithlachascotee and Anclote Rivers and Cypress Creek. The average daily discharge from the area for the period January 1964-June 1966, was 2,300 cfs. No permanent regional declines in surface or groundwater levels have occurred in the area. Principal outflow from the hydrologic system is evapotranspiration which amounts to about 67% of the total outflow. Runoff amounts to about 32% and direct groundwater outflow to the sea is about 1%. Rainfall averages about 55 inches annually. Eighty percent of the runoff from the area originates either as springflow or seepage to streams from the Floridan aquifer. The water-level gradients in the system are about the same as the topographic gradients (2-3 ft/mi). Water levels are highest in late summer or early fall following the rainy season and are lowest in late May or early June. The chemical quality of ground and surface water is good. Ample supplies of good quality water is good. Ample supplies of good quality water are available for existing and foreseeable uses. (Knapp-USGS)
W70-06540

TEST-WELL AND SOIL DATA, FORT MOHAVE INDIAN RESERVATION AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
Fred Kunkel.
Geological Survey Basic-data Compilation Report, August 1969. 77 p, 1 fig, 3 tab.

Descriptors: *Data collections, *Water wells, *Soils, *California, Hydrologic data, Sampling, Logging (Recording), Boreholes, Subsurface investigation.
Identifiers: Fort Mohave (Calif).

This report is a compilation of 115 lithologic logs of wells or test borings, water-level data in 14 wells, and particle-size distribution curves for eight soil samples in the Fort Mohave Indian Reservation area, California. These data were collected by the U.S. Geological Survey in 1968 and 1969 as part of a hydrologic study of the Fort Mohave Indian Reservation area as requested by the U.S. Bureau of Indian Affairs. (Knapp-USGS)
W70-06544

SUBSURFACE GEOLOGY OF THE LATE TERTIARY AND QUATERNARY WATER-BEARING DEPOSITS OF THE SOUTHERN PART OF THE SAN JOAQUIN VALLEY, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
M. G. Croft.
Geological Survey Open-file Report, 1969. 29 p, 3 fig, 6 plate, 56 ref.

Descriptors: *Hydrogeology, *Aquifers, *California, Alluvium, Permeability, Transmissivity, Groundwater movement, Recharge, Artificial recharge, Aquicludes, Hydrology, Geology.
Identifiers: *San Joaquin Valley (Calif).

The southern part of the San Joaquin Valley, California is a borad structural trough of mostly interior drainage. Unconsolidated deposits blanket the underlying consolidated rocks in the valley and are the source of most of the fresh groundwater. Alluvium is composed of coarse arkosic deposits derived from the Sierra Nevada, Tehachapi, and San Emigdio Mountains. The coarse oxidized deposits of the alluvium are the most permeable aquifers along the eastern and southern margins of the valley. The coarse oxidized continental and alluvial deposits are the most permeable strata along the western margin of the valley and contain most of the fresh-water body. Artificial recharge will be more successful if sites are located in areas underlain by these deposits. Flood-basin, lacustrine, and marsh deposits, which are nearly impermeable, are chiefly aquicludes and do not transmit water fast enough to furnish an appreciable supply for a well. Lacustrine-clay tongues are virtually impermeable horizons that separate the alluvial sequence into several aquifers. (Knapp-USGS)
W70-06545

WATER RESOURCES DEVELOPMENT IN MONGOLIA.
Economic Commission for Asia and the Far East (UN), New York.
For primary bibliographic entry see Field 02E.
W70-06548

THERMAL SPRINGS OF THAILAND,
Kaset Pitakpaivan.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 69-74, 1969. 6 p, 1 fig, 1 tab.

Descriptors: *Thermal waters, *Mineral waters, *Springs, Aquifers, *Groundwater, Mapping, Geology, Water temperatures, Igneous rocks, Limestones, Sandstones, Fissures (Geology), Water utilization.
Identifiers: *Thailand.

Thailand has 37 occurrences of thermal and mineral springs. The temperature of these springs ranges from 29 to 100 deg C and their waters carry very small amounts of dissolved minerals, especially of sulfur. Geologically, the greatest number of springs are distributed within the belt of younger granites which form the core of the mountain range in the whole length of western Thailand. Two springs located in northern Thailand and the eastern coast are utilized for therapeutic purposes. (Gabriel-USGS)
W70-06551

THERMAL AND MINERAL SPRINGS OF SOUTH VIETNAM (FRENCH),
H. Fontaine.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 63-68, 1969. 6 p, 3 fig, 1 tab, 5 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, Groundwater, *Aquifers, Water temperature, Water chemistry, Mapping, Carbonates, Sulfates, Silica, Sodium, Potassium, Calcium, Magnesium, Discharge (Water).
Identifiers: *South Vietnam.

About 50 occurrences of thermal and mineral waters with temperatures ranging from 40 to 83 deg. C are located in South Vietnam. The mineral content of these waters does not exceed 6 g/l and in the majority of cases is less than 1 g/l. Basaltic intrusions and extrusions of Tertiary, to recent ages may be considered as the primary source of these waters. The spring waters of South Vietnam may be classified as follows: Sodium bicarbonates, bicarbonates and sodium sulfates, chlorides, and calcium sulfates. (Gabriel-USGS)
W70-06552

MINERAL AND THERMAL WATERS OF JAPAN,
Hisayoshi Nakamura.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 45-62, 1969. 18 p, 6 fig, 8 tab, 12 ref.

Descriptors: *Mineral waters, *Thermal waters, *Springs, *Aquifers, *Groundwater, Geology, Boreholes, Water chemistry, Water temperature, Mapping, Pumping, Heat flow.
Identifiers: *Japan, Geothermal powerplants.

There are about 13,000 hot springs in Japan. Most of these hot springs are distributed along Quaternary volcanic zones whose basement rocks mainly consist of green tuff of Tertiary age. These spring waters contain considerable amounts of Cl, sulfates, carbonates, Na, K, Al, Fe, and silicates. The hot springs are widely used in Japan for therapeutic treatment, bathing, and geothermal power generation. (Gabriel-USGS)
W70-06553

MINERAL AND THERMAL WATERS OF INDIA,
G. C. Chaterji.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 21-43, 1969. 23 p, 5 plate, 3 tab, 7 ref.

Descriptors: *Mineral water, *Thermal water, *Springs, *Aquifers, *Groundwater, Geology, Mapping, Water temperature, Water chemistry, Hydrogen sulfide, Radioactivity, Discharge (Water), Chlorides, Sulfates, Sodium, Calcium, Heat, Water supply.
Identifiers: *India.

There are over 300 recorded occurrences of thermal and mineral waters in India, with mineral waters limited to about a dozen occurrences only. These waters are associated with different geological formations ranging in age from Archean to Quaternary. The temperature of the springs varies from 28 to 102 degree C. The hotter springs discharge carbon dioxide, hydrogen sulfide, and occasionally inert gases. Many springs are radioactive, although most of the springs have a low mineral content (500-1000 ppm). Trap formations contain saline chloride waters (200-3000 ppm). The source of water supply for all the springs is infiltration, with an addition of juvenile or magmatic components in the Himalayan region. (Gabriel-USGS)
W70-06554

THERMAL AND MINERAL WATERS OF TURKEY (FRENCH),
Cahit Erentoz, and Zati Ternek.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Praque, p 75-84, 1969. 10 p, 2 fig, 1 tab, 4 ref.

Descriptors: *Thermal water, *Mineral waters, *Springs, *Aquifers, *Groundwater, Water temperature, Water chemistry, Water sources, Water utilization, Sulfates, Carbonates, Silicates, Radioactivity, Mapping, Discharge (Water).
Identifiers: *Turkey.

There are about 529 sources of thermal and mineral waters in Turkey with a temperature range of 15.0 to 7.90 deg C. The majority of these springs are associated with regional fault systems and seismic regions, in rocks of different compositions and age. Chemical analysis of these thermal and mineral springs shows relatively large contents of Na, K, Ca, Mg, Cl, bicarbonate, sulfate, silica, and carbon dioxide. The majority of springs are radioactive. The waters of many springs are utilized for therapeutic purposes. (Gabriel-USGS)
W70-06555

MINERAL AND THERMAL WATERS OF KENYA,
J. Walsh.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 105-110, 1969. 6 p, 1 fig, 1 tab, 6 ref.

Descriptors: *Mineral water, *Thermal water, *Springs, *Aquifers, *Groundwater, Geology, Igneous rocks, Lakes, Water chemistry, Water utilization, Water temperature, Heat flow, Silica, Sulfates, Carbonates, Trace elements.
Identifiers: *Kenya.

Mineral and thermal waters are known in many localities in Kenya, mostly within the Great Rift Valley where they are closely connected with the volcanicity of the area. The majority of the thermal waters are of meteoric origin and considered to be heated by carbon dioxide gas emanating from cooling syenitic magma. Attempts have been made to find large volumes of pressurized steam for the production of electric power, and research is still continuing. The major exploitation of mineralized waters is at Lake Magadi, where 120,000 metric tons of sodium salts are extracted annually. (Gabriel-USGS)
W70-06556

THERMAL AND MINERAL SPRINGS OF MOROCCO (FRENCH),
M. Combe.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 121-137, 1969. 17 p, 3 fig, 3 tab, 5 ref.

Descriptors: *Thermal water, *Mineral waters, *Springs, *Aquifers, Groundwater, Water utilization, Water chemistry, Water temperature, Discharge (Water), Mapping, Geology, Radioactivity, Calcium, Magnesium, Sodium, Carbonates, Silica, Trace elements.
Identifiers: *Morocco.

There are 50 recorded thermal and mineral springs with temperatures ranging from 12 to 50 deg C in Morocco, with 30 springs recognized as possessing some therapeutic characteristic. The spring water reservoirs are in water-bearing horizons consisting of various rock types at depths in the majority of cases not exceeding 500 M. Analysis of spring waters indicates the presence of considerable amounts of Ca, Mg, Na, Cl, sulfate, silica, and free carbon dioxide. (Gabriel-USGS)
W70-06557

THE THERMAL SPRINGS OF MALAWI,
Geological Survey of Malawi, Zomba.
I. M. Kirkpatrick.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 111-120, 1969. 10 p, 1 fig, 1 tab, 11 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Water temperature, Water chemistry, Water sources, Water utilization, Geology, Mapping, Carbonates, Calcium, Sodium, Silica, Magnesium, Sulfates, Trace elements.
Identifiers: *Malawi.

The location and chemical composition of the thermal springs with temperatures ranging from 29 to 78.3 deg C and disseminated through the 23 localities of Malawi are tabulated. Ca, Mg, Na, K, Silica, Cl, carbonate, and sulfate can be considered the main mineral components. The springs are mostly associated with the Rift Valley faults and their mineralized waters are not utilized at present. (Gabriel-USGS)
W70-06558

THERMAL AND MINERAL SPRINGS IN UGANDA,
C. G. Dixon, and W. H. Morton.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 191-200, 1969. 10 p, 1 fig, 3 tab, 8 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Geology, Mapping, Water temperature, Water chemistry, Discharge (Water), Water utilization, Structural geology, Salinity, Salts, Carbonates, Calcium, Magnesium, Lakes, Sulfates, Potassium.
Identifiers: *Uganda.

Geohydrological and chemical characteristics of 17 mineral and thermal springs of Uganda are described. Most of the thermal and mineral waters are in or near the Western Rift Valley and are associated with volcanic centers, while 5 are in the eastern part of the country not far from the Eastern Rift Valley of Kenya. The temperature of these waters ranges from 20 to 100 deg C and their chemical analysis shows the presence of Na, K, Ca, Mg, Cl, sulfate, carbonate, borate, carbon dioxide, hydrogen sulfide, and chlorine. The waters are utilized for the production of salt. (Lake Katwe, Lake Kasenyi, and Lake Albert), limestone (Muhoyka, Dura River, and Hima River), and for bathing. (Gabriel-USGS)
W70-06559

MINERAL AND THERMAL WATERS OF RWANDA (FRENCH),
A. Bertossa.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 139-142, 1969. 4 p, 1 fig, 1 tab, 1 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Water temperature, Water chemistry, Water utilization, Mapping, Geology, Permeability, Fissures (Geology), Sodium, Potassium, Silica, Calcium, Magnesium, Carbonates, Sulfates, Trace elements.
Identifiers: *Rwanda.

A brief description of hydrogeological and chemical characteristics of 9 thermal and mineral water occurrences in Rwanda is presented. Some of these waters are characterized by their above-30 deg C temperature, their deep source origin, and their association with the tectonics of Central Africa and regional volcanism. Six other waters are of mineral type and have water temperatures below 25 deg C. The thermal and mineral waters are characterized by the presence of silica, Ca, Mg, Na, K, Cl, bicarbonate, sulfur dioxide, and some trace elements. (Gabriel-USGS)
W70-06560

RECENT REVIEW OF INVESTIGATIONS ON THE THERMAL AND MINERAL SPRINGS IN THE U.A.R.,
Ismail Mahmoud El Ramly.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 201-213, 1969. 13 p, 1 fig, 2 tab, 11 ref.

Descriptors: *Mineral waters, *Thermal water, *Springs, *Aquifers, *Groundwater, Mapping, Geology, Water temperature, Water chemistry, Water utilization, Discharge (Water), Trace elements, Gases, Sodium, Potassium, Calcium, Carbonates, Sulfates.
Identifiers: *U.A.R.

The U.A.R. has about 1,450 flowing springs, mainly associated with carbonate rocks of different geological ages. Some of these springs have a temperature up to 75 deg C and their salinity ranges from a very small amount to the brine state of 35,000 ppm. Detailed chemical analysis of 30 springs shows the presence of considerable amounts of Na, K, Ca, Mg, bicarbonate, sulfate, and Cl. Several springs contain rare elements and gases. In several parts of the country the spring waters are used for irrigation, bathing, and therapeutic purposes. (Gabriel-USGS)
W70-06561

THERMAL AND MINERAL WATERS OF ZAMBIA,
W. H. Reeve.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 215-221, 1969. 7 p, 1 fig, 3 ref.

Descriptors: *Thermal waters, *Mineral waters, *Springs, Aquifers, Groundwater, Mapping, Geology, Water chemistry, Water utilization, Water temperature, Discharge (Water), Radioactivity, Salinity, Calcium, Sodium, Potassium, Chlorides, Sulfates, Magnesium.
Identifiers: *Zambia.

There are many springs in Zambia associated with the fractures of the Rift Valley. Analysis of the

waters of 8 springs shows the presence of considerable amounts of K, Na, Ca, Mg, Cl, sulfate, and carbonates. Some radium-bearing springs are located in the region of the confluence of the Kafue and Lunga Rivers. (Gabriel-USGS)
W70-06562

THERMAL AND MINERAL WATERS IN CHILE,
Joaquin Sanchez Rojas.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 257-263, 1969. 7 p, 1 fig, 1 tab, 4 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Aquifers, *Groundwater, Mapping, Geology, Water temperature, Salinity, Discharge (Water), Gases, Sulfates, Calcium, Sulfur.
Identifiers: *Chile.

A simplified map of Chile shows the locations of 44 thermal and mineral waters. A table contains temperature, discharge, and chemical composition data. The temperature of the waters ranges from 20 to 90 deg C and the main mineral constituents are salt, sulfur, carbon dioxide, and sulfur dioxide. Several waters are utilized for bathing and therapeutic purposes. (Gabriel-USGS)
W70-06563

THERMAL AND MINERAL SPRINGS OF JAMAICA,
H. R. Versey.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 265-268, 1969. 4 p, 1 fig, 1 tab, 3 ref.

Descriptors: *Thermal waters, *Mineral waters, *Springs, Aquifers, *Groundwater, Water temperature, Discharge (Water), Water utilization, Water chemistry, Radioactivity, Calcium, Magnesium, Sodium, Potassium, Carbonates, Silica, Sulfates, Mapping.
Identifiers: *Jamaica.

Temperature, discharge, radioactivity, and mineral content of 5 thermal and 3 nonthermal mineral springs of Jamaica are given. Ca, Mg, Na, K, sulfate, bicarbonate, carbon dioxide, silica, and Cl are the chief mineral constituents. The springs of Bath of St. Thomas, Milk River Bath, Rockfort Baths, and Black River Spa are utilized for bathing and therapeutic purposes. (Gabriel-USGS)
W70-06564

THERMAL AND MINERAL WATERS OF TUNISIA (FRENCH),
A. Djellouli.
In. Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 181-190, 1969. 10 p, 2 fig, 2 tab, 6 ref.

Descriptors: *Thermal waters, *Mineral water, *Springs, *Aquifers, *Groundwater, Boreholes, Water temperature, Water chemistry, Water utilization, Water sources, Water law, Hydrogeology, Mapping, Geology, Calcium, Magnesium, Sodium, Sulfates, Gases.
Identifiers: *Tunisia.

Temperature, discharge, utilization and chemical composition of the 44 most important thermal and mineral springs of Tunisia are described. The waters, associated with Triassic formations, can be subdivided into the following mineralization types: chlorides; sulfates; bicarbonates; sulfides, and metal-bearing. The temperature of these springs ranges from 20 to 45 deg C in 28 occurrences and from 45 to 75 deg C in 12 occurrences. Many of these springs are utilized for bathing and commercial bottling. (Gabriel-USGS)
W70-06565

MINERAL AND THERMAL WATERS OF CANADA,
J. G. Souther, and E. C. Halstead.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 225-256, 1969. 32 p, 7 fig, 2 tab, 25 ref.

Descriptors: *Mineral waters, *Thermal waters, *Springs, *Aquifers, *Groundwater, Geology, Water temperature, Water chemistry, Water analysis, Water utilization, Discharge (Water), Mapping, Radioactivity, Calcium, Magnesium, Carbonates, Sodium, Potassium, Sulfates, Sulfides, Carbon dioxide.
Identifiers: *Canada.

The distribution and character of mineral and thermal waters in Canada are closely associated with regional topographic and geologic features. All known thermal springs in Canada occur in the Cordilleran region where high relief permits deep circulation of meteoric water. Nonthermal mineral springs are mainly brine springs associated with Paleozic marine sedimentary rocks. Detailed description of 58 thermal and 28 nonthermal mineral springs are given. The mineral content of both thermal and nonthermal springs may be explained by solution aquifer minerals. Ca, K, Mg, Na, bicarbonate, sulfate, Cl, Si, silica, carbon dioxide, and hydrogen sulfide are the chief constituents of these springs. The springs of Canada are utilized for salt production, the sale of bottled mineral water, and for therapeutic purposes. (Gabriel-USGS)
W70-06566

THERMAL AND MINERAL WATERS OF THE UNITED STATES--BRIEF REVIEW OF POSSIBLE ORIGINS,
Geological Survey, Austin, Tex.
Donald E. White.
In: Proceedings of Symposium II on Mineral and Thermal Waters of the World, B-Overseas Countries, Vol 19, Report of 23rd Session of International Geological Congress, 1968, Academia Prague, p 269-286, 1969. 18 p, 1 fig, 58 ref.

Descriptors: *Thermal water, *Mineral water, *Springs, *Reviews, Aquifers, Groundwater, *United States, Surveys, Water types, Water temperature, Water chemistry, Connate water, Meteoric water, Magmatic water, Geology, Geochemistry, Sediments, Brines, Gases, Discharge (Water).
Identifiers: Thermal water classification.

The origin of thermal and mineral waters of the United States is briefly reviewed. The following genetic classes are recognized: meteoric waters characterized by recent contact with the atmosphere; enclosing rocks; partly connate water; partly metamorphic water; juvenile water; and partly volcanic or magmatic water. Chemical composition and hydrogeology of these waters are given. (Gabriel-USGS)
W70-06567

EFFECTIVE USE AND CONSERVATION OF GROUNDWATER,
For primary bibliographic entry see Field 04B.
W70-06570

GEOLOGY AND GROUNDWATER RESOURCES OF THE MORGANTON AREA, NORTH CAROLINA,
Geological Survey, Raleigh, N.C.
Carlton T. Sumsion, and R. L. Laney.
North Carolina Department Water Resources Groundwater Bulletin No 12, March 1967. 119 p, 29 fig, 3 plate, 26 tab, 26 ref.

Descriptors: *Water resources, *North Carolina, *Groundwater, Surface waters, Geology, Hydrogeology, Aquifers, Water wells, Water quality, Hydrologic data, Data collections, Water yield, Water supply, Water levels.
Identifiers: Morganton (NC).

The Morganton area is located in the west-central part of North Carolina. Streams and drainage courses are of geologically subsequent development on fracture systems which have clearly defined patterns throughout most of the area. Groundwater is obtained from weathered rock or saprolite and alluvium by dug and bored wells. Drilled wells derive groundwater from joint and shear openings in unweathered bedrock. Wells drilled in low, flat areas and narrow, linear valleys have greater yields than wells drilled on high ground or slopes. The present rate of groundwater withdrawal has only local effect on the height of the water table. The amount of groundwater contained in bedrock decreases with depth, hence drilling wells deeper than about 300 feet usually will not substantially increase well yields. Generally, groundwater is slightly acid, contains less than 150 ppm dissolved solids, is soft (less than 50 ppm hardness as calcium carbonate), and contains less than 0.3 ppm iron. (Knapp-USGS)
W70-06575

WATER RESOURCES OF WISCONSIN, ROCK-FOX RIVER BASIN,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02E.
W70-06577

A STUDY OF THE HYDROLOGY AND GEOLOGY OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
David K. Todd, and Charles F. Meyer.
Prepared for Board of Water Supply City and County of Honolulu. Completion Report 70-TMP-20, April, 1970. 79 p, 6 tab, 17 fig, 28 ref, 2 append.

Descriptors: *Aquifer characteristics, *Groundwater recharge, *Saline water-freshwater interfaces, Basalts, Drawdown, Hawaii, Hydrogeology, Mathematical models, Safe yield, Water quality.

This study is the first part of a project to develop a mathematical model and to simulate by use of a digital computer the dynamic behavior of isochlors when fresh water floats on salt water. Studies are made of the flow of groundwater and its mixing with underlying seawater in one part of the highly permeable basalt of the Honolulu aquifer. Withdrawal at rates exceeding the sustainable yield has caused shallow drawdown cones with severe upcoming of brackish water. By the Theis nonequilibrium method permeability is estimated to be 13,700 gpd/sq ft. Recharge into the area, calculated by three different methods, is found to be about 5-1/2 mgd. Leakage of fresh water to the ocean or to adjacent aquifer areas appears to be negligible, since withdrawal at approximately the recharge rate causes no increase in salinity. (See also W70-06706).
W70-06705

A STUDY OF DATA PREPARATION FOR MATHEMATICAL MODELING OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
David C. Kleinecke, and Charles F. Meyer.
Prepared for Board of Water Supply City and County of Honolulu. Completion Report 70 TMP-21, April, 1970. 69 p, 9 fig, 3 append. OWRR Project C-1875 (No 3175) (2).

Descriptors: *Automation, *Data processing, *Saline water-freshwater interfaces, Mathematical models, Hawaii, Hydrologic data.

This study is the second part of a project to develop a mathematical model and to simulate by means of a digital computer the dynamic behavior of

isochlors when fresh water floats on salt water. Reviews are made of records of water level, draft, salinity, and rainfall for one part of the Honolulu aquifer. It is concluded that records are adequate for developing a mathematical model of water salinity although insufficient to develop a flow model. Need is noted for more measurements to define 1000-foot-thick transition zone between fresh and salt water; for better evaluation of inflow; and for water extraction and outflow records outside of research area. Recommendations are made for data digitizing procedures and automated process control. (See also W70-06705)
W70-06706

2G. Water in Soils

LIQUID-LIMIT DETERMINATION FOR INDICATING EFFECTIVENESS OF CHEMICALS IN POND SEALING,
Tennessee Univ., Knoxville.
For primary bibliographic entry see Field 03B.
W70-06374

SOIL WATER EVAPORATION, ISOTHERMAL DIFFUSION, AND HEAT AND WATER TRANSFER,
Iowa State Univ., Ames.
D. D. Fritton, Don Kirkham, and R. H. Shaw.
Soil Science Society of America Proceedings, Vol 34, No 2, p 183-189, March-April 1970. 7 p, 6 fig, 25 ref. OWRR Proj No A-003-IA.

Descriptors: *Evaporation, *Soil water, *Diffusion, Heat transfer, Mass transfer, Diffusivity, Water temperature, Winds, Solar radiation, Soil water movement.
Identifiers: Soil water evaporation.

Temperature and water distribution data were taken for a 9- by 11- by 20-cm soil column where wind was the evaporation agent and for a similar soil column where radiation was the evaporation agent. A Webster silty clay loam soil characterized by a soil-water retention curve and an inflow diffusivity versus water content curve was used in the experiments. The experimental results were compared with results calculated from a solution of the diffusion equation normally used to describe isothermal movement of soil water and from a heat and mass transfer solution which accounted for temperature effects. It was found that the isothermal diffusion equation would describe the cumulative evaporation for the wind and for the radiation treatments. The isothermal diffusion equation did not predict the formation of a surface layer of dry soil, and thus, did not describe the water distributions for the radiation treatment for times greater than 20 hours or for the wind treatment for times greater than 200 hours. A heat and mass transfer equation did predict the development of a dry surface layer and did describe the water distribution where temperature gradients were important. (Knapp-USGS)
W70-06523

EFFECTS OF SALINE WATER ON THE CHEMICAL PROPERTIES OF SOME TROPICAL SOILS,
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.
S. A. El-Swaify, and L. D. Swindale.
Soil Science Society of America Proceedings, Vol 34, No 2, p 207-211, March-April 1970. 5 p, 2 fig, 5 tab, 23 ref. OSW Contract No 14-01-001-673.

Descriptors: *Water chemistry, *Soil chemistry, *Saline water, *Soil chemical properties, Acidity, Ion exchange, Cation exchange, Leaching, Irrigation water, Irrigation effects.
Identifiers: Tropical soils, Saline water irrigation.

Surface and subsurface samples of soils representing the Tropical Red Earths and Tropical Red Deserts were equilibrated with unbuffered salt solutions which had the composition of sea water and ranged in concentration between 0.61N and 0.0061N. The original acidities of these soils were highly resistant to change. Neither soil showed a tendency to accumulate salts by extraction from percolating solutions. To eliminate the possible interference by calcium carbonate in observed ionic equilibria, Na-Ca exchange studies were conducted on carbonate-free soils samples. Isoconcentration isotherms were constructed at electrolyte concentrations of 0.01, 0.1, and 1.0N, compared with isotherms calculated from the US Salinity Laboratory's regression equation. Large discrepancies were observed at 1.0N concentration, particularly for the lowest soil horizons. For that concentration, it was found that predictions of ionic distribution based on the theory of the diffuse double layer can closely describe Na-Ca equilibrium when large values of surface charge densities are assumed. (Knapp-USGS)
W70-06524

QUANTITATIVE PREDICTION OF LEACHING IN FIELD SOILS,
North Carolina State Univ., Raleigh. Dept. of Soil Science.
D. L. Terry, and C. B. McCants.
Soil Science Society of America Proceedings, Vol 34, No 2, p 271-276, March-April 1970. 6 p, 4 fig, 4 tab, 16 ref.

Descriptors: *Leaching, *Soil water movement, Soil chemistry, Ion transport, Porosity, Percolation, Fertilizers, Path of pollutants, Ion exchange, Adsorption, Statistical methods.
Identifiers: Soil leaching.

Leaching experiments were conducted under controlled water regime conditions on a variety of soils in the field to study the distribution of certain ions by percolated water. When ammonium, nitrate, and K ions were leached, their movement was generally in the form of a 'normal' distribution. The movement of Mg was not as well defined as the other ions. Multiple regression equations for predicting the leaching of these ions were developed which utilize the parameters of a normal distribution as the dependent variables and properties of the soil and quantities of percolated water as the independent variables. The values for mean movement ranged from 0.92 to 0.97 and those for the standard deviation from 0.56 to 0.91. The principal independent variables were quantity of percolated water, soil porosity as expressed by the weighted porosity index, cation exchange capacity, and the water content at 0.1 bar suction. (Knapp-USGS)
W70-06525

INFRARED ANALYSIS OF PARTIALLY DEUTERATED WATER ADSORBED ON CLAY,
Agricultural Research Service, Watkinsville, Ga. Southern Branch.
Ralph A. Leonard.
Soil Science Society of America Proceedings, Vol 34, No 2, p 339-343, March-April 1970. 5 p, 6 fig, 23 ref.

Descriptors: *Adsorption, *Clay minerals, *Soil water, *Soil structure, *Ion exchange, Spectroscopy, Stable isotopes, Infrared radiation, Hydrogen bonding, Hydration, Montmorillonite, Water structure, Deuterium, Clays, Clay minerals.
Identifiers: Infrared spectoscopy.

Partially deuterated water (HDO) adsorbed on Na, K, Mg, and Ca saturated montmorillonite clays was studied by use of infrared spectroscopy. Positions of the primary O-D absorption band of adsorbed HDO were 2533, 2530, 2506 and 2526/cm, respectively. In addition, a small secondary band was found at 2670/cm. This band may arise from an O-D group very weakly H-bonded to a surface oxygen, or to water isolated in hexagonal cavities in the surface. No evidence of strong H-bonding to the mineral surface was evident. At low water contents, the exchangeable cation exerts the dominant force affecting the structure of the adsorbed water. (Knapp-USGS)
W70-06527

VARIATIONS IN TENSION LYSIMETER LEACHATE VOLUMES,
State Univ. of New York, Syracuse. Dept. of Silviculture.
P. H. Cochran, Giles M. Marion, and Albert L. Leaf.
Soil Science Society of America Proceedings, Vol 34, No 2, p 309-311, March-April 1970. 3 p, 2 fig, 4 tab, 5 ref. NSF Grants GB-1279, GB-2396, and GB-6178.

Descriptors: *Soil water movement, *Lysimeters, *Leaching, Irrigation water, Rainfall, Percolation, Infiltration, Nutrients, Ion transport, Solutes, Instrumentation.
Identifiers: Tension lysimeters.

Leachate volumes collected with tension plate lysimeters placed in a glacial outwash soil and maintained at a fixed tension varied from 1.9-629.9% of the total water applied through rainfall and/or irrigation. The amounts of K passing through plates at depths of 152 cm ranged from 0.02-86.1% of that applied at the surface. These differences were attributed to several factors including nonuniform application of water, large differences in soil moisture retention and flow properties for individual strata, and irregularity of soil strata arrangement at different locations within the study area. Lateral flow to plate surfaces can result in large overestimates of the nutrient flux at a given soil depth. (Knapp-USGS)
W70-06528

WATER REPELLENCY AND INFILTRATION RESISTANCE OF ORGANIC-FILM-COATED SOILS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation. Lab.
For primary bibliographic entry see Field 03B.
W70-06531

2H. Lakes

PRELIMINARY STRATIGRAPHY OF UNCONSOLIDATED SEDIMENTS FROM THE SOUTHWESTERN PART OF LAKE MICHIGAN,
Illinois State Geological Survey, Urbana; and Illinois Univ., Urbana.
For primary bibliographic entry see Field 02J.
W70-06324

MINOR ELEMENT GEOCHEMISTRY OF LAKE MICHIGAN FERROMANGANESE NODULES,
Argonne National Lab., Ill., and Michigan Univ., Ann Arbor.
David N. Edgington, and Edward Callender.
Earth and Planetery Science Letters, Vol 8, No 2, p 97-100, April 1970. 4 p, 1 fig, 1 tab, 15 ref.

Descriptors: *Bottom sediments, *Lake Michigan, *Trace elements, *Geochemistry, *Manganese, Arsenic compounds, Eutrophication, Analytical techniques, Surveys, Dissolved oxygen, Water chemistry, Water quality, Water pollution effects.
Identifiers: Manganese nodules, Green Bay.

Samples of ferromanganese nodules from several localities in Lake Michigan were analyzed for their minor element content by neutron activation techniques. The thorium and uranium levels in Lake Michigan nodules exhibit marked dissimilarities with marine nodules. The radium content of these freshwater nodules is substantially higher than the reported marine values. The concentrations of barium in the Lake Michigan nodules appear to be abnormally high, and patterns obtained using the electron microprobe suggest it is evenly dispersed throughout the nodules. The average arsenic content of these freshwater nodules is at least twice as great as that reported for highly oxidized marine sediments. If all this arsenic is dissolved and released into Green Bay as a result of changing en-

vironmental conditions (eutrophication), the concentration in the water of Green Bay would be several times the maximum permissible level for drinking water. (Knapp-USGS)
W70-06325

THE REDOX POTENTIALS IN SMALL OLIGO AND MEROMICTIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
For primary bibliographic entry see Field 05C.
W70-06327

CURRENTS IN FRENCHMAN BAY AREA OF LAKE ONTARIO,
Ontario Water Resources Commission, Toronto.
M. D. Palmer.
Ontario Water Resources Commission, Great Lakes Survey Program, February 1970 (revised). 39 p, 5 fig, 7 tab, 5 ref, 1 append, addendum.

Descriptors: *Lake Ontario, *Currents (Water), Current meters, Flow, Lakes, Drifting (Aquatic), Water circulation, Topography.
Identifiers: Frenchman Bay (Lake Ontario).

Two recording current meters were operated from June to August, 1968, in 12.7m of water at distances of 2.42m and 4.6m from the bottom approximately 1.6km offshore in the Frenchman Bay area of Lake Ontario. A time series analysis was carried out on the resulting data for the various months. A maximum current of 21 cm/sec. observed was significantly lower than results obtained by similar current meter studies in adjacent areas and farther offshore. This appears to be a result of the shore geometry which reduced the currents in the area. Both the directions and peristence factors agree with results of other studies. Wind does not appear to be directly responsible for currents in the area which are produced as a result of diurnal, inertial and Lake Ontario free oscillation effects. The thermal regimes were a direct consequence of inertial effects. (Knapp-USGS)
W70-06344

THE WATER BUDGET OF A PRAIRIE POTHOLE,
Geological Survey, Denver, Colo.
William S. Eisenlohr, Jr.
In: Quaternary Geology and Climate, Publication 1701, National Academy of Sciences, Wash, DC, p 61-64, 1969. 4 p, 1 tab, 2 ref.

Descriptors: *Hydrologic budget, *Lakes, *Ponds, *Grasslands, Limnology, Evapotranspiration, Evaporation, Rainfall, Seepage, Discharge (Water).
Identifiers: Prairie potholes.

The glaciated prairies of north-central United States contain thousands of shallow topographic depressions, called prairie potholes. These depressions are generally elliptical, less than half a square kilometer in area, and hold water from precipitation and runoff for at least a month, usually without overflowing. The prairie potholes are a part of the habitat along the international flyways of migratory waterfowl. Water budgets of the prairie potholes are representative of a climate that seems to have had no great fluctuations since the recession of the glaciers, because if the climate had been much wetter, drainage channels would be more numerous than they are, and if it had been much drier, the potholes would be filled to a greater extent by aqueous and eolian deposits. The principal items in a water budget for a prairie-pothole pond are precipitation on the pond surface, runoff over frozen or saturated ground or from torrential rainstorms, outflow seepage, and evapotranspiration. The seasonal evapotranspiration is about the same from all ponds. Few potholes overflow and, except in limited areas, there seems to be no groundwater inflow. The outflow-seepage rate is very low, but the overall quantity of water involved is large because of the large number of potholes. (Knapp-USGS)
W70-06353

THEORY OF WATER WAVES GENERATED BY A TIME-DEPENDENT BOUNDARY DISPLACEMENT,
California Univ., Berkeley. Hydraulic Engineering Lab.
Edward Noda.
Available from the Clearinghouse as AD-699 414, $3.00 in paper copy, $0.65 in microfiche. Doctoral thesis, Rept no. HEL-16-5, Oct. 1969, 231 p. 67 fig, 20 ref. Contract DACW72-67-C-0002.

Descriptors: Waves (Ocean), Waves (Water), Landslides, Oceans, Bays, Model studies, Alaska.
Identifiers: Lituya Bay.

The study of water waves generated by landslides in reservoirs and waves generated by submerged landslides in the ocean is carried out by assuming two distinct types of landslides: a vertical landslide modeled by a box falling vertically and a horizontal landslide modeled by a wall moving horizontally. Theoretical solutions to two- and three-dimensional time-dependent boundary-motion problems are obtained using the linear theory of gravity surface waves and the two-dimensional solution is applied to these two models of landslides. Experimental data for the vertical landslide model are compared to the theoretical solution and are found to compare favorably for small values of the box width and velocity. The region of validity of this solution is also determined. A final comparison of this theory to prototype landslides is made for the Lituya Bay, Alaska landslide of 9 July 1958.
W70-06456

SELECTIVE WITHDRAWAL FROM A STABLY STRATIFIED FLUID,
New South Wales Univ., Kensington (Australia). Water Research Lab.
I. R. Wood.
Journal of Fluid Mechanics, vol. 32, part 2, 1968, p. 209-223. 7 fig., 9 ref.

Descriptors: *Stratification, *Reservoirs, *Density stratification.
Identifiers: *Selective withdrawal.

In this paper a reservoir connected through a horizontal contraction to a channel is considered. Both the reservoir and the channel are considered to contain a stable multi-layered system of fluids. The conditions under which there is a flow in only one layer, the depth in this flowing layer decreases continuously from its depth in the reservoir to its depth in the channel, give the maximum discharge that can be obtained with a flow only from this single layer. Where there are velocities in only two layers and the depth in each of these layers decreases continuously from their depths in the reservoir to their depths in the channel, the theory involves computations at two sections in the flow. Experiments have been carried out with a contraction in a flume for the withdrawal of two discrete layers from a three layer system and the withdrawal from a fluid with a linear density gradient. In both cases the reservoir and channel bed and hence the lowest streamline was effectively horizontal. These experiments confirmed the theoretical predictions. (Guerrero-Vanderbilt)
W70-06634

A NOTE ON THE STABILITY OF AN INFINITE FLUID HEATED FROM BELOW,
Imperial Coll. of Science and Technology, London (England). Dept. of Mathematics.
J. L. Robinson.
Journal of Fluid Mechanics, Vol 29, Part 3, p 461-464, 1967. 4 ref.

Descriptors: *Thermal stratification, *Theoretical analysis, Temperature.
Identifiers: *Prandtl number, Temperature profile.

The problem of the stability of a fluid with time-dependent heating has been investigated by Morton (1957), Lick (1965) and Foster (1965). Morton and Lick assumed that the rate of change of the temperature profile is small compared with the growth rate of the disturbances (quasi-static assumption). This assumption is invalid near the onset of instability (as defined by (the partial derivative with respect to $t = 0$)), and Foster has therefore used an initial-value approach. The range of validity of the quasi-static assumption is discussed, and results of a time-scaled analysis and calculations based on this are compared with the work of Foster; the agreement is found to be good. This study was restricted to a semi-infinite fluid initially at a constant temperature; at time $t=0$ a temperature difference delta T is applied at the (lower) horizontal boundary (case (A) of Foster). (Guerrero-Vanderbilt)
W70-06638

DISPERSAL OF ALGAE, PROTOZOANS, AND FUNGI BY AQUATIC HEMIPTERA, TRICHOPTERA, AND OTHER AQUATIC INSECTS,
North Texas State Univ., Denton. Dept. of Biology.
For primary bibliographic entry see Field 05C.
W70-06655

ON THE SIGMOID GROWTH PHASE IN THE HISTORY OF LINSLEY POND,
Duke Univ., Durham, N.C. Dept. of Zoology.
D. A. Livingstone.
American Journal of Science, Vol 255, p 364-373, 1957. 4 fig, 18 ref.

Descriptors: *History, *Connecticut, *Growth stages, Sedimentation rates, Organic matter, Inorganic compounds, Silting, Plankton, Nutrients, Phosphorus, Glaciers, Productivity, Depth, Phosphates, Ecosystems, Pollen, Biomass, Mud, Zooplankton, Phytoplankton, Adsorption, Ion exchange, Diatoms, Oligotrophy, Eutrophication, Paleolimnology, Stratigraphy.
Identifiers: *Linsley Pond (Conn), Bosmina, Microfossils, Biocoenosis, Gyttja.

The principal change in the stratigraphy of Lower Linsley Pond is a sigmoid increase in organic and microfossil sediment content. This investigation shows that the sigmoid increase is associated with extra-lacustrine changes and may have resulted from world-wide postglacial warming. New calculations are presented involving previously published data. Using the brown bands of Vallentyne and Swabey as a time scale, Bosmins counts and organic-inorganic measurements of Deevey have been translated into terms of sedimentation/square centimeter per year. Recalculated results show that the apparent logarithmic increase in Bosmina production early in the lake's history is valid, but that the logarithmic increase in organic matter is largely an artifact due to previous methods of calculation. The most significant change during this period was a decrease in the rate of inorganic sedimentation. It is suggested that silting controlled the production of Bosmina and other plankton organisms in the lake's early history and again in recent years, by interfering with the regeneration of nutrients in the diagenetic layer. This is supported by the correspondence between the ratio of phosphorus to total organic matter, calculated from the data of Hutchinson and Wollack, and the ash content of the sediment. (Jones-Wisconsin)
W70-06659

TWO METHODS OF DESCRIBING THE 'AVERAGE' VERTICAL TEMPERATURE DISTRIBUTION OF A LAKE,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
H. E. Sweers.
Journal Fisheries Research Board of Canada, Vol 25, No 9, p 1911-1922, 1968. 3 fig, 3 ref.

Descriptors: *Lakes, *Water temperature, Methodology, Isotherms, Thermocline, Lake Ontario, Stratification.
Identifiers: *Vertical temperature distribution, Temperature gradients, Sinusoidal internal waves, Temperature profiles.

Average vertical pattern of temperature in a freshwater, stratified lake can be obtained by computation of the average temperature at different levels or by computation of the average depth of a number of isotherms. The latter technique promises a more realistic approximation of temperature profiles, especially in the thermocline region. (Wilde-Wisconsin)
W70-06665

STUDIES ON ASTERIONELLA FORMOSA HASS. II. NUTRIENT DEPLETION AND THE SPRING MAXIMUM, PARTS I AND II,
Freshwater Biological Association, Ambleside (England).
J. W. G. Lund.
Journal of Ecology, Vol 38, No 1, p 1-35, 1950. 5 fig, 6 tab, 81 ref.

Descriptors: *Nutrients, *Spring, Diatoms, Silica, Nitrates, Phosphates, Fungi, Parasitism, Calcium, Sampling, Seasonal, Cycles, Sewage, Cyanophyta, Eutrophication, Silts, Chlorophyceae, Depth, Floods, Light intensity, Temperature, Grazing, Chlorella, Nitzschia, Silicates, Carbon, Hydrogen ion concentration, Alkalinity, Iron, Manganese, Chara.
Identifiers: *Spring maximum, *Asterionella formosa Hass, *Windermere (England), *Esthwaite Water (England), *Blelham Tarn (England), Flagellates, Sphaerocystis, Schroeteri, Desmids, Fragilaria crotonensis, Tabellaria fenestrata, Rhizophidium planktonicum, Cyclotella, Oscillatoria, Coelenterates, Lamellibranchs, Zooxanthellae, Dinobryon, Stephanodiscus.

Observations were made during five years, from winter to summer, on numerical fluctuation of Asterionella formosa and other diatoms, and on varying concentrations of dissolved silica, nitrates and phosphates in three English lakes. The close of the spring Asterionella increase is not directly affected by light or temperature, but is frequently due to depletion of silica. Grazing by animals had no appreciable effect on numerical variation. Fungal parasitism may affect the course of the spring increase, but rarely causes its termination. Diatoms cannot multiply appreciably when the silica concentration is less than 0.5 milligrams per liter, but availability of silica does not provide a complete explanation of fluctuations in diatom numbers. The mean silica content of Asterionella formosa cells is 140 micrograms per million. The amount of silica per unit area of cell is constant under all conditions. The nitrogen content in natural and cultural populations varied from 6 to 12 micrograms/million cells. Phosphorus content varied widely; Asterionella cells can store phosphorus in excess of immediate requirements, concentration in the water being 1 microgram per liter or less. Asterionella can utilize calcium at a concentration of 400 micrograms per liter. (Jones-Wisconsin)
W70-06670

SUPPLEMENTAL REAERATION OF LAKES AND RESERVOIRS,
Vanderbilt Univ., Nashville, Tenn. Dept. of Sanitary and Water Resources Engineering; and New Mexico State Univ., University Park. Dept. of Sanitary Engineering.
Edward L. Thackston, and R. E. Speece.
Journal American Water Works Association, Vol 58, p 1317-1324, 1966. 1 fig, 23 ref.

Descriptors: *Aeration, *Water circulation, *Reservoirs, Oxygenation, Oxygen sag, Bubbles, Lakes, Stratification, Dissolved oxygen, St Lawrence Seaway, Application methods.
Identifiers: *Reaeration methods, Supplemental reaeration, Ossining Reservoir (N Y), Lake Wohlford (Calif), Folsom Dam (Calif), Oconto River (Wis), European lakes.

Methods of supplemental aeration, or rather mixing stratified water to bring the stagnant hypolimnion in contact with atmospheric oxygen, are reviewed. The first attempts to mix a stratified body of water by a centrifugal pump were replaced by the use of compressed air introduced into the hypolimnion through a perforated hose. Promising results were obtained with aerohydraulic guns shooting air bubbles to the surface from submerged tubes. Drainage of a reservoir to a lower location, submerged weirs, monitoring dissolved oxygen, selective withdrawal of water, passing river water through spray nozzles, and Bunger valves are among other methods of correcting the dissolved oxygen deficit. Stirring surface of water, even when accomplished by paddle-wheel steamers, had little effect. (Wilde-Wisconsin)
W70-06672

PHOTOPERIOD CONTROL OF DIAPAUSE IN DAPHNIA. II. INDUCTION OF WINTER DIAPAUSE IN THE ARCTIC,
Arctic Inst. of North America, Washington, D.C.
Raymond G. Stross.
Available from the Clearinghouse as AD-699 018, $3.00 in paper copy, $0.65 in microfiche. Prepared in cooperation with State Univ. of New York, Albany, Department of Biology. Published in The Biological Bulletin, V. 136, No. 2, p. 264-273, Apr 69. Contract Nonr-3996 (01).

Descriptors: *Crustaceans, Reproduction, *Daphnia, *Photoperiodism, Climatology, Aquatic microorganisms, Food chanis, *Arctic.
Identifiers: *Daphnia middendorffiana, Barrow, Alaska.

Control of the sexual polymorphism leading to an embryonic diapause was studied in an arctic population of Daphnia middendorffiana. The reproductive cycle is similar to a previously analyzed population of D, pulex although males are non-functional in the polymorphism. Results of this study support the previous hypothesis in part, namely, that the sexual polymorphism in short-day induced populations of Daphnia may be under the control of photoperiod. Also shown is the latitudinal adjustment necessary for functioning of photoperiod at mid and high latitudes.
W70-06709

2I. Water in Plants

SWAMP VEGETATION-AN INDICATOR FOR NON-FROZEN AREAS IN THE NORTHERN TAIGA OF WESTERN SIBERIA,
For primary bibliographic entry see Field 02C.
W70-06396

2J. Erosion and Sedimentation

PRELIMINARY STRATIGRAPHY OF UNCONSOLIDATED SEDIMENTS FROM THE SOUTHWESTERN PART OF LAKE MICHIGAN,
Illinois State Geological Survey, Urbana; and Illinois Univ., Urbana.
D. L. Gross, J. A. Lineback, W. A. White, N. J. Ayer, and Charles Collinson.
Illinois State Geological Survey Environmental Geology Note No 30, February 1970. 20 p, 6 fig, 2 plate, 11 ref.

Descriptors: *Bottom sediments, *Lake Michigan, Mineralogy, Water chemistry, Clay minerals, Glacial drift, Sampling, Dating.
Identifiers: Lake Michigan sediments.

Sampling of the unconsolidated sediments of southern Lake Michigan was begun in the summer of 1969. The geology and the chemistry of these sediments was studied with emphasis on their pollution, as measured by lead and other inorganic constituents. The sediment sequence includes, from the top, a few centimeters of sandy silty clay on the lake floor; 0.5 to 1.0 meter of dark gray silty clay alternating with thin black clay layers; 0.5 meter of brownish gray silty clay containing thin dark layers; 0.75 meter of orangish brown clay in which there is a traceable gray clay bed 0.15 meter thick; and a homogeneous, pink clay more than 1.0 meter thick that overlies glacial outwash and till. The black layers in the upper part of the cores have yielded a radiocarbon date of 6920 plus or minus 200 years B.P. Within the lacustrine sediments, grain size decreases with depth. Water content ranges from 100% to more than 200% of dry weight. Illite, chlorite, kaolinite, and expandable clay minerals are mixed throughout the cores, although expandables decrease downward and kaolinite decreases upward. (Knapp-USGS)
W70-06324

MINOR ELEMENT GEOCHEMISTRY OF LAKE MICHIGAN FERROMANGANESE NODULES,
Argonne National Lab., Ill., and Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 02H.
W70-06325

SEDIMENTATION IN PLUM CREEK SUBWATERSHED NO. 4, SHELBY COUNTY, NORTH-CENTRAL KENTUCKY,
Geological Survey, Washington, D.C.
Peter W. Anttila.
Report available for sale by Superintendent of Documents, U S Government Printing Office, Washington, D C 20402. Geological Survey Water-Supply Paper 1798-G, p GI-G54, 1970. 54 p, 17 fig, 1 plate, 8 tab, 10 ref.

Descriptors: *Reservoir silting, *Sedimentation, *Kentucky, Sediment load, Reservoirs, Sediment yield, Sediment control, Small watersheds, Deposition (Sediments), Reservoir design.
Identifiers: Plum Creek (Ky).

The sedimentation investigation of Plum Creek subwatershed No. 4 above Tucker Dam, Kentucky was part of a cooperative nationwide investigation of trap efficiency. Runoff from 28 percent of the 1.55-square-mile drainage area passes through several livestock-watering ponds formed by earthfill dams before reaching reservoir No. 4. The principal source areas eroded are thought to be barnyards, plowed fields (10 percent of the subwatershed), grazing land and cropland in SCS land capability class VI, and land cultivated in Lowell soils. The sediment yield from the 1.55 square miles was estimated to be 4.03 tons per square mile per year for the period between March 20, 1957, and April 2, 1959, and 5.44 tons per square mile per year between April 2, 1959, and May 20, 1964. Storm runoff accounted for 93 percent of the 1,860 tons of sediment per year discharged from reservoir No. 4 and this runoff occured in 6 percent of the period of investigation, April 1, 1956, to September 30, 1964. All the sand (generally less than 5 percent of the total suspended sediment) and a substantial amount of the silt and clay entering the reservoir are trapped. If sediment deposition continues at the average rate that was measured during the investigation, 2.15 acre-feet per year, the useful life of reservoir No. 4 will be 46 years. The trap efficiency, computed from measured weight of sediment outflow and estimated weight of sediment deposition, averaged 92 percent. (Knapp-USGS)
W70-06334

SUSPENDED-SEDIMENT LOAD OF TEXAS STREAMS, COMPILATION REPORT OCTOBER 1963--SEPTEMBER 1965,
Texas Water Development Board, Austin.
H. M. Cook.
Texas Water Development Board Report 106, January 1970. 62 p, 1 fig.

Descriptors: *Suspended load, *Texas, Streams, Streamflow, Data collections, Hydrologic data, Sedimentation, Sediment load, Sediment discharge.
Identifiers: Suspended sediment load (Tex).

Suspended sediment load data for Texas streams, 1963-65, are tabulated. During the period covered

by this report, the Texas Water Commission operated 36 suspended-sediment sampling stations. Data resulting from sediment investigations for 13 stations operated by the International Boundary and Water Commission, United States and Mexico and three stations operated by the United States Geological Survey are included. Samples are collected in 8-ounce narrow-neck bottles at a position approximately 1 foot below the water surface near midstream. The percentage of suspended sediment by weight obtained from the sample is multiplied by the factor 1.102 to obtain the mean percentage of suspended sediment in the vertical profile. Laboratory determinations were equated to the corresponding streamflow in determining the total suspended-sediment load. (Knapp-USGS)
W70-06342

DETERMINATION OF THE MANNING COEFFICIENT FROM MEASURED BED ROUGHNESS IN NATURAL CHANNELS,
Geological Survey, Menlo Park, Calif.
For primary bibliographic entry see Field 02E.
W70-06352

STUDY ON THE LONGITUDINAL PROFILE OF RIVER BED (JAPANESE),
Public Works Research Inst., Tokyo (Japan).
Akihiko Tsuchiya, and Katsuyoshi Ishizaki.
Report on Public Works Research Institute, Tokyo, Japan, Vol 136, p 1-12, March 1969. 12 p, 15 fig, 82 ref.

Descriptors: *Channel morphology, *Rivers, *Sediment transport, Sedimentation, Stream erosion, Channel improvement, Scour, Profiles.
Identifiers: Joganji River (Japan).

The two fundamental concepts of equilibrium theory of river bed profile and successive calculation of river bed fluctuation were examined and applied to improvement projects in stable river channels. The existing longitudinal bed profile could not be explained well by the equilibrium theory. Lack of equilibrium in the existing river was shown by the changing river-bed profile. A fundamental equation which expresses river bed variation was determined and applied to the Joganji River. The calculated results showed that the mechanism of river bed variation was well explained by the equation. A design criteria of stable river channels was based on the fundamental concept of river bed variation. (Knapp-USGS)
W70-06356

A SYSTEM FOR MEASURING AND SAMPLING RUNOFF CONTAINING SEDIMENT AND AGRICULTURAL CHEMICALS FROM NEARLY LEVEL LANDS,
Agricultural Research Service, Baton Rouge, La.
G. H. Willis, J. M. Laflen, and C. E. Carter.
Trans Amer Soc Agr Eng, Vol 12, No 5, p 584-587, Sept-Oct 1969. 4 p, 1 fig, 4 tab, 7 ref.

Descriptors: *Sediments, Chemicals, Water resources, Agriculture, Head loss, *Runoff, Samplers, Rainfall, Watersheds (Basins), Parshall flumes, Weirs, Volume, Analysis, Endrin, Chromatography, Clays, Water pollution, Silts, Pollutants, Models, *Agricultural chemicals, Measurement, *Water pollution sources, Pesticides, Nitrates, Water analysis.
Identifiers: Coshocton sampler.

Controversies over suggestions that agricultural chemicals might be polluting water resources of this nation make it imperative that the quality of runoff from agricultural lands be characterized accurately. To do this, special care must be exercised to collect samples that truly represent the runoff. A Parshall flume, Geib multislot divisor, sump pump, and storage tanks, appropriately arranged, provided a system that measured runoff with reasonable accuracy and collected representative samples of the runoff. Very little head loss through the system was experienced. The vertical distance from the flume entrance to the divisor outlet was 4.5 in. Little difference was apparent in silt, clay, nitrates, or endrin contents in overall comparisons between slot and channel samples for all flow rates and sediment concentrations tested. All endrin entering the system was recovered proportionately in the sample. (USBR)
W70-06369

DEPOSITION AND SCOUR DOWNSTREAM FROM SEMIPERMEABLE STRUCTURES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulic and Water Power.
For primary bibliographic entry see Field 08A.
W70-06385

A STATISTICAL STUDY OF SAND WAVES,
Kayoto Univ. (Japan). Disasters Prevention Research Inst.
K. Ashida.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B12, p 103-110, 1967. 8 p, 10 fig, 3 tab, 5 ref.

Descriptors: *Sand waves, *Dunes, *Roughness (Hydraulic), Statistical methods, Markov processes, Stochastic processes, Time series analysis, Bed load, Regime, Sounding.
Identifiers: Spectral analysis.

Statistical characteristics of sand waves should be useful for describing the bed roughness quantitatively. Analog and digital records of bed elevation are obtained as a function of both distance and time by a supersonic sounder for various regime of bed forms: namely, ripples, dunes, transition and standing waves. The characteristics of autocorrelation and spectral density function are discussed with relation to the bed regimes. The process of bed elevations for both dunes and standing waves is approximately represented by a Markov second-order linear process but the process for both ripples and transition should be represented by higher order Markov process. The authors also discuss the relation between two spectral density functions concerning distance and time. Moreover, the authors discuss the distribution of the wave heights and lengths. (Knapp-USGS)
W70-06395

THE BIRTH AND DEVELOPMENT OF THE CONCEPT OF DIAGENESIS,
Strasbourg Univ. (France). Inst. of Geology.
For primary bibliographic entry see Field 10.
W70-06398

HILLSLOPE SEDIMENTATION AND SOIL FORMATION IN NORTHEASTERN IOWA,
Iowa State Univ., Ames.
Harold J. Kleiss.
Soil Science Society of America Proceedings, Vol 34, No 2, p 287-290, March-April 1970. 4 p, 4 fig, 5 ref.

Descriptors: *Sedimentation, *Particle size, *Alluvium, *Soil formation, *Slopes, Soil profiles, Soils, Sands, Glacial drift, Deposition (Sediments), Ion exchange, Organic matter.
Identifiers: Sorting (Sediments).

Systematic investigation of a hillslope from summit to alluvial positions revealed that particle size variations within the soil A horizons are due to sedimentological sorting. The mean particle size in the surficial sediments follows a systematic decrease within two subset systems down the hillslope. Each subset is expressible mathematically. A discordance in the backslope position is caused by truncation of a sand zone within the till underlying the surficial material. Hillslope sedimentation has also influenced accumulation of organic matter, bulk density, and cation exchange capacities in the soils formed at various positions on the slope. Profile characteristics indicate little pedogenic development; rather, many of the soil properties are inherited from the sedimentary nature of the hillslope surficial sediment. (Kanpp-USGS)
W70-06526

COMMUNITY ACTION GUIDEBOOK FOR SOIL EROSION AND SEDIMENT CONTROL,
National Association of Counties Research Foundation, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-06574

2K. Chemical Processes

MINOR ELEMENT GEOCHEMISTRY OF LAKE MICHIGAN FERROMANGANESE NODULES,
Argonne National Lab., Ill., and Michigan Univ., Ann Arbor.
For primary bibliographic entry see Field 02H.
W70-06325

THE REDOX POTENTIALS IN SMALL OLIGO AND MEROMICTIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
For primary bibliographic entry see Field 05C.
W70-06327

FURTHER STUDIES OF PROPERTIES OF SEA WATER AND ITS CONCENTRATES TO 200 DEG C,
California Univ., Berkeley.
For primary bibliographic entry see Field 03A.
W70-06331

RECONNAISSANCE OF WATER TEMPERATURE OF SELECTED STREAMS IN SOUTHEASTERN TEXAS,
Geological Survey, Austin, Tex.
Jack Rawson.
Texas Water Development Board Report 105, January 1970. 13 p, 4 fig, 2 tab, 5 ref.

Descriptors: *Water temperature, *Streams, *Texas, Surveys, Data collections, Hydrologic data, Water quality.
Identifiers: Stream water temperature (Tex).

Temperature-profile measurements were made at 61 cross sections of 7 major streams in Texas. No cross-sectional variations of temperature were observed during 147 measurements. Only 34 measurements showed a temperature difference of more than 0.5 deg C within a cross section; the maximum difference encountered was 1.5 deg C. Therefore, point-temperature records reported by the U.S. Geological Survey in Texas are usually representative of the average temperature of water within the stream cross section. Air temperature is a reasonable index of the temperature of the major streams in the State--provided that temperature is not affected by such artificial influences as addition of treated wastes or presence of impoundments. At 8 sites where artificial influence was not significant, the mean monthly water temperatures, as computed from once-daily observations, seldom differed from corresponding mean monthly air temperatures by more than 2 deg C and often differed by no more than 1 deg C. The temperatures of Texas streams vary widely from month to month. The spread between observed monthly maximum and minimum temperatures averages 3-6 deg C. (Knapp-USGS)
W70-06343

PRELIMINARY RESULTS FROM STATISTICAL ANALYSIS OF WATER QUALITY IN SELECTED STREAMS OF NEBRASKA,
Geological Survey, Lincoln, Nebr.
For primary bibliographic entry see Field 05A.
W70-06349

VARIATIONS IN THE CHEMICAL QUALITY OF GROUNDWATER BENEATH AN IRRIGATED FIELD, CEDAR BLUFF IRRIGATION DISTRICT, KANSAS,
Geological Survey, Lawrence, Kans.
Robert B. Leonard.
Kansas Department of Health Environmental Health Services Bulletin 1-11, 1969. 20 p, 11 fig, 1 tab, 3 ref.

Descriptors: *Water quality, *Groundwater, *Irrigation water, *Leaching, *Kansas, Recharge, Infiltration, Solutes, Aqueous solutions, Water chemistry, Mineralogy, Soil water, Groundwater movement, Hydrogeology.
Identifiers: Cedar Bluff (Kans).

The concentrations of the major ions in the waters from closely spaced observation wells in a cultivated field in the Cedar Bluff Irrigation District, Kansas varied widely from well to well. Percolation of irrigation water into the aquifer and lateral displacement of the original groundwater progressively changed the ionic composition of most of the waters during the first 3 years of irrigation. The average concentration of chloride in the groundwater underlying the field decreased from about 220 to 130 mg/liter and the outflow exceeded inflow of chloride for the period November 1965 to October 1967. Although the concentration of sulfate also decreased slightly during the same period, the quantity of sulfate in storage remained nearly constant. If the observed changes are representative of changes occurring elsewhere in the district, they substantiate the conclusion that progressively increasing contributions of groundwater runoff from the irrigation district raised the concentration of chloride in low streamflow of the Smoky Hill River adjacent to the district. (Knapp-USGS)
W70-06358

APPLICATION OF COMPUTER TECHNIQUES TO SEEPAGE-SALINITY SURVEYS IN KANSAS,
Geological Survey, Lawrence, Kans.
For primary bibliographic entry see Field 07C.
W70-06508

QUANTITY AND QUALITY OF LOW FLOW IN THE PECOS RIVER BELOW GIRVIN, TEXAS, FEBRUARY 6-9, 1968,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-06511

TRITIUM CONCENTRATION IN PRECIPITATION, 1967-1968,
Southwestern Radiological Health Lab., Las Vegas, Nev.; and Southeastern Radiological Health Lab., Montgomery, Ala.
For primary bibliographic entry see Field 05B.
W70-06515

EFFECTS OF SALINE WATER ON THE CHEMICAL PROPERTIES OF SOME TROPICAL SOILS,
Hawaii Univ., Honolulu. Dept. of Agronomy and Soil Science.
For primary bibliographic entry see Field 02G.
W70-06524

QUANTITATIVE PREDICTION OF LEACHING IN FIELD SOILS,
North Carolina State Univ., Raleigh. Dept. of Soil Science.
For primary bibliographic entry see Field 02G.
W70-06525

INFRARED ANALYSIS OF PARTIALLY DEUTERATED WATER ADSORBED ON CLAY,
Agricultural Research Service, Watkinsville, Ga. Southern Branch.
For primary bibliographic entry see Field 02G.
W70-06527

THE STRUCTURE OF WATER,
Ambassador Coll., Pasadena, Calif. Dept. of Chemistry.
For primary bibliographic entry see Field 01A.
W70-06537

THERMAL SPRINGS OF THAILAND,
For primary bibliographic entry see Field 02F.
W70-06551

THERMAL AND MINERAL SPRINGS OF SOUTH VIETNAM (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06552

MINERAL AND THERMAL WATERS OF JAPAN,
For primary bibliographic entry see Field 02F.
W70-06553

MINERAL AND THERMAL WATERS OF INDIA,
For primary bibliographic entry see Field 02F.
W70-06554

THERMAL AND MINERAL WATERS OF TURKEY (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06555

MINERAL AND THERMAL WATERS OF KENYA,
For primary bibliographic entry see Field 02F.
W70-06556

THERMAL AND MINERAL SPRINGS OF MOROCCO (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06557

THE THERMAL SPRINGS OF MALAWI,
Geological Survey of Malawi, Zomba.
For primary bibliographic entry see Field 02F.
W70-06558

THERMAL AND MINERAL SPRINGS IN UGANDA,
For primary bibliographic entry see Field 02F.
W70-06559

MINERAL AND THERMAL WATERS OF RWANDA (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06560

RECENT REVIEW OF INVESTIGATIONS ON THE THERMAL AND MINERAL SPRINGS IN THE U.A.R.,
For primary bibliographic entry see Field 02F.
W70-06561

THERMAL AND MINERAL WATERS OF ZAMBIA,
For primary bibliographic entry see Field 02F.
W70-06562

THERMAL AND MINERAL WATERS IN CHILE,
For primary bibliographic entry see Field 02F.
W70-06563

THERMAL AND MINERAL SPRINGS OF JAMAICA,
For primary bibliographic entry see Field 02F.
W70-06564

THERMAL AND MINERAL WATERS OF TUNISIA (FRENCH),
For primary bibliographic entry see Field 02F.
W70-06565

MINERAL AND THERMAL WATERS OF CANADA,
For primary bibliographic entry see Field 02F.
W70-06566

THERMAL AND MINERAL WATERS OF THE UNITED STATES--BRIEF REVIEW OF POSSIBLE ORIGINS,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02F.
W70-06567

CYCLING OF CHLORINE THROUGH A FORESTED WATERSHED IN NEW ENGLAND,
Dartmouth Coll., Hanover, N.H. Dept. of Earth Sciences.
Franz H. T. Juang, and Noye M. Johnson.
Journal of Geophysical Research, Vol 72, No 22, p 5641-5647, November 15, 1967. 7 p, 3 tab, 21 ref. NSF Grants GB4169 and GB1144.

Descriptors: *Chlorides, *Small watersheds, *Water chemistry, Leaching, Rainfall, Runoff, Infiltration, Seepage, Groundwater movement, Soil-water-plant relationships, Geochemistry, Hydrologic budget, Hydrologic cycle, Hydrogeology.
Identifiers: Chloride cycle, Chloride budget.

The annual chloride budget of two small forested watersheds in New Hampshire has been measured for the period September 1965 through August 1966. Chemical sampling was done on a weekly basis. Average yearly chloride concentration in precipitation and run-off water was 0.2 and 0.5 mg/liter, respectively. Using a network of rain gage and stream flow data, the total amount of chloride entering and leaving the system was calculated. It was found that 410 kg/sq km of chloride annually moves through the watersheds. During the study period two-thirds of the chloride input into the system was from wet removal of atmospheric chloride; the remaining one-third was attributed to dry removal by an impaction and/or adsorption process on the forest canopy. Chemical weathering and direct cultural activities do not contribute measurably to the chloride budget of the study area. (Knapp-USGS)
W70-06571

CHLOROPHYLLS,
Chicago Univ., Ill. Dept. of Botany.
L. Bogorad.
Physiology and Biochemistry of Algae, R A Lewin, editor, Academic Press, New York, 1962. p 385-408. 2 fig, 2 tab, 89 ref.

Descriptors: *Chlorophylls, Metabolism Algae, Chlorella, Euglena, Distribution, Properties, Chlorophyta, Euglenophyta, Chrysophyta, Phaeophyta, Pyrrophyta, Cyanophyta, Rhodophyta, Absorption, Nutrients, Light intensity, Temperature, Age, Scenedesmus, Chlamydomonas, Cyanidium, Anacystis.
Identifiers: Biosynthesis, Biliproteins, Carotenes, Xanthophylls, Xanthophyta, Bacillariophyta, Cryptophyta, Pheophytin, Chlorella, Euglena gracilis, Scenedesmus obliquus, Porphyridium, Synechococcus, Navicula, Cryptomonas, Gonyaulax, Nostoc.

This is a digest of literature concerning properties and distribution of chlorophyll, including the history of biosynthesis of chlorophyll. Use of algae for chlorophyll metabolism investigations was motivated by interst in algae and by their facility in experimentation; Chlorella and Euglena were studied primarily. From spectral data, functional chlorophylls in vivo are not in the same molecular state as chlorophylls dissolved in organic solvents, but nature of these differences remains unresolved.

Studies on algae cultured under controlled laboratory conditions reveal that mineral nutrition, light intensity, and cell age can be major factors in influencing the concentrations of chlorophyll in an individual organism. Relation of chlorophyll content, cell number, and cell size to light intensity is discussed. Experiments with the crossed-gradient plate also demonstrated that the chlorophyll content of various algae can change rapidly as cells age and the culture medium becomes depleted of mineral nutrients; the green zone generally moves from lower to higher temperatures within the same light-intensity range. Streptomycin, heat, chlortetracycline, acriflavine, and pyribenzamine have been reported to induce development of strains lacking chlorophyll. (Jones-Wisconsin)
W70-06661

2L. Estuaries

INFLUENCE OF TIDAL INLETS ON SALINITY AND RELATED PHENOMENA IN ESTUARIES,
Texas Univ., Austin. Hydraulic Engineering Lab.
Frank D. Masch.
Available from the Clearinghouse as PB-191 707, $3.00 in paper copy, $0.65 in microfiche. Technical Report HYD 16-7001, CRWR 49, March, 1970. 107p, 6 tab, 30 fig, 21 ref. OWRR Project B-023-TEX (1).

Descriptors: *Estuaries, *Bays, *Tidal inlets, *Tidal hydrodynamics, *Salinity distributions, Mathematical models, Convective dispersion.
Identifiers: Pass openings, Gulf coast, Physical exchange.

This study presents mathematical hydrodynamic and salinity transport models applicable to the analysis of the effects of tidal inlets on bays and estuaries having the typical morphology encountered in the U.S. coastal regions on the Gulf of Mexico. The practical utility of these models has been developed and demonstrated for the following specific cases: (1) Simulation of tidal hydrodynamics and salinity distributions under well-mixed water conditions for two bays on the Texas Gulf coast; (2) Analysis of the effects of altering natural tidal inlets on estuary-Gulf exchange and on salinity concentration, transport and distribution. Analyses were conducted on both idealized and real estuaries; (3) Simulation and analysis of hypothetical shell reef removal. Specifically, Matagorda Bay, Texas, was used to verify both the tidal hydrodynamic model and salinity distribution model. Galveston Bay, Texas, was used to demonstrate the effects of altering the size of the tidal inlet on water interchange and salinity distribution. Using computed 'baseline' conditions for low and intermediate freshwater inflows to Galveston Bay, the assumption was made that an improved, continuously open tidal inlet was created at Rollover Pass into the Galveston Bay system. Changes in salinities, salinity gradients, Gulf inflows, tidal prisms, and circulation were computed for intermediate and low fresh water inflows. (Runkles-Texas A and M University)
W70-06315

A STUDY SUBMERGED DREDGE HOLES IN NEW JERSEY ESTUARIES WITH RESPECT TO THEIR FITNESS AS FINFISH HABITAT,
New Jersey Dept. of Conservation and Economic Development. Nacote Creek Research Station.
Walter S. Murawski.
New Jersey Division of Fish and Game Miscellaneous Report No 2-M, October 1969. 32 p, 6 tab, 6 chart, 3 ref, 2 append. Fish and Wildlife Service Project F-15-R.

Descriptors: *Aquatic habitats, *Fish conservation, *Stream fisheries, *Estuarine fisheries, *Dredging, Dissolved oxygen, Water quality, Aquatic environment, Estuarine environment, Limnology.
Identifiers: Dredge holes.

Thirty-eight submerged dredge holes in New Jersey estuaries were examined with respect to their fitness as finfish habitat. Water quality parameters examined were temperature, salinity, dissolved oxygen concentration and hydrogen sulfide concentration. Of the 38 holes, 21 had dissolved oxygen and/or hydrogen sulfide conditions that could not sustain healthy fish life. Of the 33 holes examined for invertebrate fauna, 20 lacked any bottom invertebrates. The highest amounts of organic matter and the highest concentrations of soluble ferrous and manganese ions in the bottom muds were associated with stagnant holes. The reasons for the stagnation of these holes are: too great a depth in relation to the surrounding water, intrusion of poor quality groundwater, abnormally high accumulation of detritus, and prevention of mixing. Although the formation of stagnant or semistagnant holes is not recommended, some were of benefit in that they retained warm water in fall and winter, thus concentrating the fish at mid-depths, which is of value to the angler. (Knapp-USGS)
W70-06362

FRESH WATER WHITECAPS,
Hobart and William Smith Colleges, Geneva, N.Y.
Edward C. Monahan.
Available from the Clearinghouse as AD-698 977, $3.00 in paper copy, $0.65 in microfiche. Jnl of Atmospheric Sciences, V. 26, No. 5, Pt. 2, p. 1026-1029, Sept. 69. ONR Contract N00014-68-C-0409, NR 083-212.

Descriptors: *Waves, Lake morphometry, Lakes, Great Lakes, Winds, Velocity, Air temperature, Thermal properties, Hygrometry, Anemometers, Bubbles.
Identifiers: *Whitecaps, Lake Superior, Lake Huron, Lake Erie, Detroit Edison vessel, Naugatuck vessel, Air water interactions, Wind velocity.

Photographic observations of the whitecap coverage of large fresh water lakes were made in conjunction with measurements of wind velocity, and air and surface water temperatures. The fraction of the water surface covered by whitecaps shows an abrupt increase as the wind velocity increases from approximately 7 to approximately 8 m/sec. This abrupt change is qualitatively in accord with the published observations of 'critical' wind velocities associated with numerous other water-surface and surface-related phenomena. The whitecap coverage of fresh water bodies, particularly at the higher wind velocities, is much less than the published values of whitecap coverage of oceans under the same wind conditions.
W70-06459

DISTRIBUTION OF BENTIC FAUNA IN THE WESTERN BERING SEA BY TROPHIC ZONES AND SOME GENERAL PROBLENS OF TROPHIC ZONATION,
Naval Oceanographic Office, Washington, D.C.
A. P. Kuznetsov.
Available from the Clearinghouse as AD-699 862, $3.00 in paper copy, $0.65 in microfiche. U.S. Naval Oceanographic Office, Rept. No. NOO-Trans-460, Translation Wash. D.C., 1969. Akademiya Nauk SSSR. Institut Okeanologii. Trudy, V 69, p. 98-177 1964.

Descriptors: *Fish behavior, Food habits, *Fish diets, Fish food organisms, Ecosystems, *Benthic fauna.
Identifiers: Trophic zones, Bering Sea, USSR.

It has been found that there are five main groups among them; sessile suspension or detritus feeders, mobile suspension feeders, selective detritus eaters, non selective detritus eaters, and carnivores. The trophical zonation of the bottom fauna in the Bering and Okhotsk Sea and the Pacific coastal line of Kamtshathka and North Kurile Islands are compared. A correlation between the trophic zones and biocoenoses was also studied. The distribution of trophic zones along the coasts of continents is discussed and charts showing the trophical zonation of the bottom fauna in the Asov and Baltic Sea are given.
W70-06460

REPRODUCTIVE PERIODICITIES OF INDOPACIFIC INVERTEBRATES IN THE GULF OF SUEZ. I. THE ECHINOIDS PRIONOCIDARIS BACULOSA (LAMARCK) AND LOVENIA ELONGATA (GRAY),
American Univ., Cairo (Egypt).
J. S. Pearse.
Available from the Clearinghouse as AD-699 293. Bulletin of Marine Science, June 1969, V. 19, No 2, p 323-350, 28 p. Prepared in cooperation with Kerckhoff (William G.) Marine Lab., Corona del Mar, Calif.

Descriptors: Sea water, Fish food organisms.
Identifiers: Nutritive phagocytes, P. Baculosa, L. Elongata, Gulf of Suez, Echinoids.

Cellular changes in the gonads of the echinoids, Prionocidaris baculosa (Cidaroidea) and Lovenia elongata (Spatangoidea), in the Gulf of Suez are followed over a year. Gametogenesis leading to spawning begins in synchrony among individuals of P. baculosa in April, and spawn-out occurs in July and August. Gametogenesis is not as synchronous among individuals of L. elongata, it begins in mid- and late winter, and the prolonged spawning period occurs mainly between April and September. Nutritive phagocytic tissue is prominent in the gonads of both species, its globulation changing over the year, especially in L. elongata. The nutritive phagocytes are involved in gametogenesis by phagocytizing gametogenic cells during part of the year and nourishing them when gametogenesis is leading toward spawning. Fluctuations in photoperiod, salinity, and sea temperature do not seem to be directly related to the synchronization of reproduction, but accumulation of nutrients, perhaps indirectly related to the effects of sea temperature and photoperiod, may have importance in synchronization.
W70-06461

COMMUNITIES OF BENTHIC FAUNA IN THE WESTERN BERING SEA,
Naval Oceanographic Office, Washington, D.C.
Z. A. Filotava, and N. G. Barsanova.
Available from the Clearinghouse as AD-699 863, $3.00 in paper copy, $0.65 in microfiche. U.S. Naval Oceanographic Office Translation Wash., D.C., 1969. Report No. NOO-Trans-459. Akademiya Nauk SSSR. Institut Okeanologii. Trudy, V 69, p. 6-97, 1964, by M. Slessers.

Descriptors: *Benthic fauna, *Fish diets, Food habits, Fish food organisms, Ecosystems.
Identifiers: Tropic Zones, Bering Sea, USSR.

The data on the composition and distribution of the bottom fauna in the western Bering Sea were received in 1950-1952. During that period 256 stations were occupied. One hundred seventy-three quantitative samples of the bottom fauna were taken with large bottom-sampler 'Ocean-50' and Petersen grab and 64 samples were gathered with Sigsbye trawl. Forty-six of the stations were occupied at the depths exceeding 1000m and 38 of them--at depths exceeding 2000m. Eighteen communities of the bottom fauna were established in western Bering Sea. True oceanic deep-sea species are dominant in the abyssal bottom-fauna communities of the western Bering Sea. Some species living presumably on the slope of the shelf are the leading forms of bathyal communities. A great many arctic-circumpolar, arctic-boreal, and north-boreal Pacific species of the bottom fauna are part of the composition of the shallow-water communities of the western Bering Sea.
W70-06462

ANNOTATED BIBLIOGRAPHY OF RESOURCE USE, TEXAS GULF COAST,
Texas A and M Univ., College Station.
Clare A. Gunn.

Available from the Clearinghouse as PB-189 780, $3.00 in paper copy, $0.65 in microfiche. Texas A and M University Sea Grant Publication No 204, November 1969. 387 p, 2 map, 5 index.

Descriptors: *Bibliographies, *Texas, *Gulf Coastal Plain, *Natural resources, Land use, Oil, Recreation, Fisheries, Wildlife, Water resources, Estuaries, Climates, Topography, Soils, Vegetation.
Identifiers: Texas Gulf Coast.

An annotated bibliography of approximately 2300 references is presented of uses of all natural resources of the Texas Gulf Coast. The geographic coverage reaches from the Louisiana border to the boundary with Mexico and includes a ribbon of land about 75 miles wide and that portion of the Gulf of Mexico within 10 1/2 miles of the coast. All topics in the natural resource categories such as climate, wildlife, topography, soils, minerals, vegetative cover, and water are covered. Additional categories were considered, such as space, location, cultural, historic, and landscape quality. All land uses, considering both developed and undeveloped land, were included. The time span begins with current studies and reaches back to and including 1950. (Knapp-USGS)
W70-06578

THE BEHAVIOUR OF A STABLE SALINITY GRADIENT HEATED FROM BELOW,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
J. S. Turner.
Journal of Fluid Mechanics, Vol 33, Part 1, 1968, p 183-200. 7 fig, 16 ref.

Descriptors: *Density stratification, *Thermal stratification, *Model studies, *Salinity, Heated water, Boundary layers.

This study investigates theoretically and by laboratory experiments the motions resulting when a linear, stable salt gradient is heated uniformly and at a steady rate from below. A convecting, growing layer is first formed whose depth temperature and salinity differences from the fluid above are all increasing as t (1/2). The way in which these quantities depend on the salinity gradient and heating rate is also predicted, and verified experimentally. A stability criterion is then developed which describes the breakdown of the diffusive boundary layer ahead of the advancing front, and leads to an expression for the thickness of the bottom layer when a second layer forms above it. The predicted form of dependence of layer thickness on the given parameters is again borne out by the experiments. Some conclusions are: (a) The results obtained point out the importance of bottom heating compared with that from the sides during the growth of the lowest layer. (b) Experiment agrees with the theory based on a negligible extra entrainment at the top of the layer due to the conversion of turbulent kinetic to potential energy; but remain the doubt whether this would continue to be true on a much larger scale. (c) With these results, it is possible to determine when a new layer will form given the heating rate and salinity gradient. (Guerrero-Vanderbilt)
W70-06636

INTERNAL WAVES IN A CONTINUOUSLY STRATIFIED ATMOSPHERE OR OCEAN,
California Univ., San Diego, La Jolla. Inst. of Geophysics and Planetary Physics.
John W. Miles.
Journal of Fluid Mechanics, Vol 28, Part 2, 1967, p 305-310. 1 tab, 9 ref.

Descriptors: *Stratified flow, *Density stratification, Ocean waves, Waves (Water).
Identifiers: *Richardson number, *Internal waves.

This study investigates a stably stratified shear flow which has the velocity profile V (1-e to the power (-y/h)) and the density profile log (rho sub 0)/rho = alpha (1-e to the power (-y/h)) in O<y< infinity and is bounded by the rigid plane y=o. It was proved that small disturbances with respect to this basic flow are stable for all wave lengths and Richardson numbers. The eigenvalues for neutral disturbances (internal gravity waves) are enumerated. Another conclusion is that the heterogeneous shear flow analyzed will support an infinite number of internal gravity waves with wave speeds that lie outside of the range of wind speeds, (O, V), but have limited points at c=O- for J> 1/4 and at c=O+ for J=O+. The results are applicable to the atmosphere and to an infinitely deep ocean. (Guerrero-Vanderbilt)
W70-06637

SOME OBSERVATIONS OF THE OCCURRENCE OF TURBULENCE IN AND ABOVE THE THERMOCLINE,
Defence Research Establishment Pacific, Victoria (British Columbia).
H. L. Grant, A. Moilliet, and W. M. Vogel.
Journal of Fluid Mechanics, Vol 34, Part 3, 1968, p 443-448. 5 fig, 3 ref, 1 tab.

Descriptors: *Thermocline, *Turbulence, *Temperature, *Stratification, Boundary layers, Oceans.

Some observations of small-scale velocity and temperature fluctuations in the upper layers of the ocean are described. A hot film flowmeter, a thin film resistance thermometer and several thermistors were mounted on a submarine and used to study turbulence and temperature microstructure in the open sea. The observations were made in the west coast of Vancouver Island. Conclusions were (a) The surface layer was found to be continuously turbulent and (b) patches of turbulence were found in and below the main ocean thermocline. The temperature structure in the thermocline was observed to be very complex with spots of vigorous turbulent mixing. (Guerrero-Vanderbilt)
W70-06645

WAVE-INDUCED SHEAR INSTABILITY IN THE SUMMER THERMOCLINE,
British Meteorological Office, Bracknell (England).
J. D. Woods.
Journal of Fluid Mechanics, Vol 32, Part 4, 1968, p 791-800. 14 fig, 19 ref.

Descriptors: *Thermocline, *Stability, *Turbulence, Temperature, Flow, Oceans.
Identifiers: *Mediterranean Sea, Malta, Temperature gradient.

This paper describes the principal fine-scale features of the summer thermocline and to establish, with the help of field observations and a simple theory, one of the major mechanisms by which its structure is controlled. The field observations were taken in the Mediterranean Sea around Malta, using a new temperature-gradient meter suitable for sounding to a maximum depth of 50 m from a small open boat and make spot measurements of temperature and temperature gradient. The thermistors had a response time of a few tenths of a second and were calibrated to plus or minus 0.01 deg C. Measurements of temperature gradients were made during the probe's descent and temperature during the subsequent ascent. In order to measure the shear across thermocline sheets, a sequence of photographs of the steady distortion of a vertical streak of dye left behind in the wake of a small pellet of soluble flurescein was taken. The principal internal feature of the thermocline is a series of thin, laminar-flow sheets of high static stability, separated by a weakly turbulent layer of only moderate density gradient and a few meters thick. A mechanism for generating the patches of turbulence observed on these thermocline sheets is established by comparing dye photographs with a theory of Miles and Howard. (Guerrero-Vanderbilt)
W70-06650

THE BALANCE BETWEEN LIVING AND DEAD MATTER IN THE OCEANS,
Kiel Univ. (West Germany). Institut fuer Meereskunde.
Johannes Krey.
International Oceanographic Congress, New York, Publication No 67, 1959. 22 ref.

Descriptors: *Balance of nature, *Oceans, Phytoplankton, Zooplankton, Nutrients, Light, Turbulence, Tripton, Standing crop, Detritus, Productivity, Chlorophyll, Proteins, Bacteria, Currents (Water), Phosphorus, Nitrogen, Copepods, Environment.
Identifiers: *Living matter, *Dead matter, Oscillating balance.

Investigation of the balance in nature between living and dead matter in oceans requires a quasi-stable state, an area and a period of time sufficiently large, such as the Atlantic Ocean, where the general bare line of population density is relatively constant. The web of relationships involves phytoplankton, zooplankton, limiting nutrients, light, water turbulence, and tripton. Knowledge of phytoplankton assimilation potential and especially of the reverse, decomposition under natural conditions, is relatively limited; these two processes should be related to proteins. Information is needed about the physiological response of zooplankton, its metabolisms and nutrient requirements; the respiration processes of zooplankton and bacteria, and the processes which bring nutrient-rich water to the surface are particularly interesting. The role of heavy oceanic storms should not be underestimated in their effect on nutrient supply. More should be known about the annual cycle of light in different ocean areas and various depths and their relationship to basic productivity. A balanced biocoenosis is theoretical--every balance must be exactly defined. The oscillating balance is actually an open unbalanced system. Heterogeneous conditions and their dynamics must be considered. (Jones-Wisconsin)
W70-06652

MARINE BACTERIA AND OTHER HETEROTROPHS AS FOOD FOR ZOOPLANKTON IN THE STRAIT OF GEORGIA DURING THE WINTER,
Fisheries Research Board, Nanaimo (British Columbia). Biological Station.
H. Seki, and Owen D. Kennedy.
Journal Fisheries Research Board of Canada, Vol 26, No 12, p 3165-3173, 1969. 5 fig, 2 tab, 27 ref.

Descriptors: *Marine bacteria, *Zooplankton, *Foods, *Winter, Microorganisms, Detritus, Standing crop, Copepods, Sampling, Yeasts, Biomass, Phytoplankton, Growth rates, Nutrients, Food chains, Chlorophyll, Sediments, Depth, Seston, Fungi, Protozoa, Pseudomonas, Oceans.
Identifiers: *Heterotrophs, *Strait of Georgia (Canada), Euphotic zone, Glucose uptake, Pseudocalanus minutus, Acartia longiremis, Oithona spinirostris, Coscinodiscus, Sagitta, Pleurobrachia, Metschnikowia.

Indications point that primary productivity in autumn and winter is low and standing crops of particulate carbon and nitrogen in the sea are minimal. The number of zooplankton nauplii in winter are often between 1-10 per liter. Heterotrophic microorganisms may be especially important in nutrient cycles and the food chain during these periods. Microbiological investigation was made in the Strait of Georgia during winter to study occurrence of heterotrophic microorganisms in relation to other particulate organic materials, including plankton and detritus. High microbial activity was measured in the euphotic zone, where marine bacteria and allied microorganisms were chiefly found on particulate matter having diameter below 25 microns. Their standing crop was estimated to be between 40 and 3000 milligrams carbon/square meter. Some of this was consumed by zooplankton, which were found to have concentrated bacteria by a factor of around 100,000. Only the highest levels of microbial production were estimated to be suffi-

cient for zooplankton growth and generally bacterial activity was only sufficient to support marine copepods at subsistence levels in the Strait of Georgia. (Jones-Wisconsin)
W70-06666

ECONOMIC EVALUATION OF WATER QUALITY: A MULTICOMPONENT MODEL OF OPTIMAL QUALITY CONTROL IN ESTUARINE WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06684

DIVERGENCE OF ISOBATHS AS A CAUSE OF CURRENT BRANCHING,
Woods Hole Oceanographic Institution, Mass.
Bruce A. Warren.
Available from the Clearinghouse as AD-698 970, $3.00 in paper copy, $0.65 in microfiche. Deep Sea Research, V. 16 Suppl., p. 339-355, 1969.

Descriptors: Flow profiles, Vortices, Bathythermographs, Flow, Mathematical models, Oceanography, Stratification.
Identifiers: Isobaths, Rossby number, Gulf stream, Depth finding, Newfoundland.

Southeast of the Grand Banks of Newfoundland, the Gulf Stream splits into two branches in an area where the underlying bottom contours spread markedly apart. The effect of divergent isobaths on a barotropic, quasi-geostrophic current is investigated under the condition of conservation of potential vorticity. The result found is that if the ratio of half the fractional depth change across the current, to the appropriate Rossby number, exceeds some critical value of order unity, then the streamlines will tend to follow the isobaths, and the current branches, if the ratio is less than the critical value, the current simply narrows and intensifies. The ratio for the Gulf Stream, suitably redefined for equivalent-barotropic flow, may be just large enough for the Stream to branch as observed. Theoretical deficiencies and observational uncertainties are stressed.
W70-06707

PHYTOL-DERIVED C19 DI- AND TRIOLEFINIC HYDROCARBONS IN MARINE ZOOPLANKTON AND FISHES,
Woods Hole Oceanographic Institution, Mass.
M. Blumer, J. C. Robertson, J. E. Gordon, and J. Sass.
Available from the Clearinghouse as AD-698 971, $3.00 in paper copy, $0.65 in microfiche. Published in Biochemistry, V. 8, No. 10, p. 4067-4074, Oct 19, 1969.

Descriptors: *Plankton, *Fish, *Aquatic microorganisms, Lipids, Nuclear magnetic resonance, Chromatography, Food chains, Zooplankton.
Identifiers: Pentadecadienes, Pentadecatrienes, Alkanes, Dienes.

Three phytol-derived olefinic hydrocarbons were isolated from marine zooplankton and fishes. Their structures have been determined by ultraviolet, infrared, nuclear magnetic resonance, and mass spectrometry and by combined gas chromatography and mass spectrometry of their ozonolysis products. They are the 2,10- and 5,10-diene and the 2,6,10-triene analogs of pristane (2,6,10,14-tetramethylpentadecane). The presumed mode of formation of these and related olefins and their fate in the marine food chain and in marine sediments is discussed. Because of their relative stability, these and related hydrocarbons provide tracers for the study of dynamic processes in the marine food chain. These olefins are not present in ancient sediments and in petroleum; therefore, they are valuable markers for the distinction between marine hydrocarbons derived from organisms and from oil pollution.
W70-06708

03. WATER SUPPLY AUGMENTATION AND CONSERVATION

3A. Saline Water Conversion

FURTHER STUDIES OF PROPERTIES OF SEA WATER AND ITS CONCENTRATES TO 200 DEG C,
California Univ., Berkeley.
L. A. Bromley.
Report available for sale by Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $1.50. Office of Saline Water Research and Development Progress Report No 522, March 1970. 166 p, 30 fig, 24 tab, 34 ref, 2 append. OSW Contract No 14-01-0001-763.

Descriptors: *Water properties, *Sea water, *Water chemistry, *Thermodynamic behavior, *Desalination, Electrolytes, Physicochemical properties, Enthalpy, Viscosity, Mixing, Saline water, Aqueous solutions, Salinity, Heat, Boiling.
Identifiers: Sea water properties.

Measurements of the heat capacity of sea water solutions to 200 deg C and up to 12% salinity are reported. Included are smoothed values for Cp, Csat, and the partial and apparent values for salts and water. These have been combined, together with relative enthalpy values determined at 25 deg C, also as a result of this study, to give enthalpy values for liquid sloutions (at thermal saturation). Heats of mixing measured at 50 deg C are shown to be consistent with these measured values. Some preliminary work on other electrolyte solutions is included. Progress is reported in attempts to measure boiling point elevations accurate to 0.001 deg C. Accurate measurements of viscosity of sea water solutions at 20 deg C are complete and smoothed values included. Graphs are also included for values at 40 and 60 deg C. Progress on equipment for measurements of viscosity to 150 deg C is reported. (Knapp-USGS)
W70-06331

FINAL REPORT ON INVESTIGATION OF DESALINATION BY FREEZING,
Westinghouse Research Labs., Pittsburgh, Pa.
R. G. Seidensticker, and R. F. Sekerka.
Report for sale by Superintendent of Documents, US Government Printing Office, Washington, DC 20402 - Price $0.75. Office of Saline Water Research and Development Progress Report No 517, March 1970. 78 p, 20 fig, 8 ref. OSW Contract No 14-01-0001-1336.

Descriptors: *Desalination processes, *Freezing, Research and development, Reviews, Water chemistry, Thermodynamics, Chemical reactions.
Identifiers: Freezing desalination.

Progress in desalination by separation or partitioning of solute between a saline solution and ice frozen from this solution is reviewed. The effective distribution of solute between a liquid and a growing solid phase is governed not only by the equilibrium partitioning characteristics, but also by the transport of rejected solute away from the interface. A Green's function method was developed to handle this problem for the difficult case of the scalloped interface frequently encountered in real freezing situations. A method was derived for determining the solute distribution in a solid when the partitioning is a function of concentration. A review of partitioning theory considers the possible causes for concentration dependent partitioning in ice. In addition to the theoretical work, the results are presented of measurements of the partitioning of HCl, NaOH, NaCl and ammonium chloride as a function of concentration. Freezing potentials were measured and a linear voltage-velocity relationship was found for dilute NaCl solutions. (Knapp-USGS)
W70-06335

RESEARCH ON NEW ION-ADSORPTION ELECTRODES FOR DEMINERALIZATION OF SALINE WATER,
General Electric Co., Schenectady, N.Y.
T. O. Rouse, and A. Factor.
Report available for sale from Superintendent of Documents, U S Government Printing Office, Wash, D C 20402 - Price $0.65. Office of Saline Water Research and Development Progress Report No 524, April 1970. 60 p, 10 fig, 10 tab, 23 ref. OSW Contract No 14-01-0001-612.

Descriptors: *Desalination processes, *Electrochemistry, *Electrodes, Electrolytes, Solubility, Water yield, Oxidation, Reduction (Chemical).
Identifiers: Ion adsorption.

This report summarizes the results of a research program on new ion adsorption electrodes for the demineralization of water. Polymers containing oxidizable or reducible organic groups thought capable of providing the necessary electrochemical reactivity and ion adsorption properties were synthesized and tested. A number of monomeric materials were also examined in order to provide insight into the necessary synthetic and electrochemical behavior. Of these, only the polyviologens and TCNQ were found to give high, reproducible electrochemical reactivity and ion adsorption. TCNQ was found to remove sodium or calcium ions from solution through the cathodic formation of slightly soluble salts. Sodium ions were preferentially removed in the presence of calcium ions. Solubility in the electrolyte and increasing inaccessibility of the salt in the porous electrode structure limit the usefulness of TCNQ in this application. The insoluble polyelectrolyte complex formed by polymeric viologen cations and polystyrene sulfonate, when precipitated on graphite powder, resulted in electrodes with cation adsorption capacities up to about 0.5 meg/g. The reaction mechanisms for the polyviologens were examined in some detail. This and possible routes to optimized electrodes are discussed. (Knapp-USGS)
W70-06510

REVERSE OSMOSIS OFFERS USEFUL TECHNIQUE FOR DESALTING,
Office of Saline Water, Washington, D.C.
For primary bibliographic entry see Field 05D.
W70-06592

3B. Water Yield Improvement

EVALUATION OF THE EFFECT OF IMPOUNDMENT ON WATER QUALITY IN CHENEY RESERVOIR,
Colorado State Univ., Fort Collins.
For primary bibliographic entry see Field 05C.
W70-06336

REGIONAL DISCRIMINATION OF CHANGE IN RUNOFF,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-06346

INFLUENCE OF MAN ON THE HYDROLOGICAL CYCLE--GUIDE TO POLICIES FOR THE SAFE DEVELOPMENT OF LAND AND WATER RESOURCES.
Food and Agriculture Organization of the United Nations.
For primary bibliographic entry see Field 06B.
W70-06370

LIQUID-LIMIT DETERMINATION FOR INDICATING EFFECTIVENESS OF CHEMICALS IN POND SEALING,
Tennessee Univ., Knoxville.
J. I. Sewell, and C. R. Mote.
Trans Amer Soc Agr Eng, Vol 12, No 5, p 611-613, Sept-Oct 1969. 3 p, 6 fig, 3 tab, 6 ref.

Descriptors: Ponds, *Soil sealants, Seepage, *Permeability, Dispersing agents, *Liquid limits, Reservoirs, Plasticity index, Reservoir leakage, Soils, Soil properties, Soil mechanics.
Identifiers: Soil plasticity, *Seepage control, Permeability tests, Canal sealants, Sodium carbonate, Sodium phosphates, *Chemical sealants.

Rapid and accurate methods are needed for selecting chemical pond sealers and determining application rates for a given soil. A probably satisfactory method involves running standard constant-head permeability tests on treated soil samples, but considerable laboratory equipment may be required and at least 30 days delay to reach steady-state permeameter discharge rates may be necessary. A quicker and simpler method for evaluating chemical treatment of some soils would be determining the decrease in liquid-limit from chemical treatment. Chemical dispersing agents used as pond sealers break soil aggregates into finer particles, reduce soil permeability, and increase fluidity of the soil-water system; and determination of liquid-limit is a method for measuring changes in the fluidity of the soil-water system. Laboratory tests made on 7 Tennessee soils treated with sodium carbonate and sodium pyrophosphate evaluated the accuracy of liquid-limit as a measurement of permeability. Results showed liquid-limit correlation with permeability for 5 plastic soils, and no correlations for a soil of plasticity and a soil of low plasticity. (USBR)
W70-06374

AN INVESTIGATION OF WATER SURFACE TEMPERATURE BY AN AIRBORNE INFRARED RADIOMETER: LAKE HEFNER, OKLAHOMA,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
W. E. Marlatt, and R. L. Grossman.
Available from Clearinghouse as PB-180 336, $3.00 in paper copy, $0.65 in microfiche. Colorado State University, Department of Atmospheric Science, Final Report to Bureau of Reclamation, January 1968. 118 p, 36 fig, 9 tab, 56 ref, 4 append. USBR Contract No 14-06-D-6022.

Descriptors: *Water temperature, *Evaporation control, *Monomolecular films, *Remote sensing, *Infrared radiation, Hexadecanol, Solar radiation, Heat transfer, Lakes, Evaporation, Reservoir evaporation, Oklahoma.
Identifiers: Lake Hefner (Okla).

The effect of a monomolecular film of hexadecanol on the surface temperature of Lake Hefner, Oklahoma, was investigated using an airborne infrared radiometer. In three of six cases studied, the monomolecular film produced a temperature rise at the water surface. The temperature rise seems to be caused by an interaction of latent heat flux and sensible heat flux from the subsurface water. The effect of the hexadecanol on the thermal gradient was to reverse it, producing a 'warm skin' temperature. Sensible heat transfer from subsurface water may be responsible for maintaining a relatively constant surface temperature. A model is presented which balances cooling of surface water by fetch variation of evaporation with fetch variation of sensible heat transfer from the subsurface water. (Knapp-USGS)
W70-06400

IMPORTANCE OF NATURAL VEGETATION FOR THE PROTECTION OF THE BANKS OF STREAMS, RIVERS AND CANALS,
P. Seibert.
In: Freshwater, Council of Europe, Nature and Environment Series, No 2, p 35-67, 1968. 33 p, 6 fig, 17 plate, 65 ref.

Descriptors: *Bank protection, *Bank stabilization, *Vegetation establishment, Erosion control, Riprap, Soil stabilization, Vegetation effects, Streams, Rivers, Canals, Environmental engineering, Hydraulic engineering, Social aspects.
Identifiers: Environmental planning.

In the course of history various methods have been successively evolved to strengthen the banks of rivers, streams and canals. Since the last century, the most common of them have relied mainly on inanimate materials; wood, stone, concrete and even iron have been used in various ways for protecting banks. The most important forms of protection are piles, wooden sleepers, slats or planks, wattling, fascines, fascine rolls, mattresses, enrockment, stone revetment, stone facings, paving, flagging with natural stone or concrete, stone-filled mattresses, gabions, metal sheet-piling, and concrete structures of every type. The utilization of living plants instead of or in conjunction with inanimate construction materials has many advantages. The degree of protection, which may be low to start with, increases as the plants grow and spread. The repair and maintenance of inert materials is replaced by the care of the riparian plants. The utilization of living plants for the protection of banks, embankments, promontories and slopes is the chief characteristic of close-to-nature hydraulic engineering. At the same time, it brings about a biological improvement of the site and of the waters and enhances the landscape. (Knapp-USGS)
W70-06401

WATER SUPPLIES FOR SELECTED SITES IN OLYMPIC NATIONAL PARK, WASHINGTON,
Geological Survey, Tacoma, Wash.
Kenneth L. Walters.
Geological Survey Open-file report, 1970. 72 p, 4 fig, 5 tab, 7 ref.

Descriptors: *Water supply, *Groundwater, *Surface waters, *National parks, *Washington, Water wells, Water yield, Water quality, Aquifers, Alluvium, Streamflow, Weather, Rainfall, Springs, Water resources development.
Identifiers: Olympic National Park.

The use of Olympic National Park, Washington is increasing to the extent that existing water-supply systems are becoming inadequate. Wells, springs, and streams were evaluated as possible sources of supply. Recorded average annual precipitation within or near the park ranges from about 17 inches to about 134 inches, but locally the annual precipitation may exceed 200 inches. The greatest precipitation occurs at the higher elevations in the western interior of the park, and the least occurs in the lowlands in the northeast part of the park, near Sequim. Several of the large rivers are undesirable as sources of water supply because they are fed by glacier melt water that contains much finely divided rock material. Also, many of the smaller streams, especially those near the Pacific Coast and in the areas of highest precipitation in the interior area, often carry water that is highly colored by decomposing vegetation. Aquifers of potentially substantial yields are restricted largely to alluvial or glacial deposits. Yields of several hundred gallons per minute probably are available only from wells tapping the alluvium of the lower Quinault and Quillayute valleys, or deltaic deposits at Fairholm and Barnes Point on Lake Crescent. (Knapp-USGS)
W70-06520

WATER RESOURCES IN THE BIG LOST RIVER BASIN, SOUTH-CENTRAL IDAHO,
Geological Survey, Boise, Idaho.
E. G. Crosthwaite, C. A. Thomas, and K. L. Dyer.
Geological Survey Open-file report, 1970. 109 p, 31 fig, 12 tab, 36 ref.

Descriptors: *Water resources, *Surface waters, *Groundwater, *Idaho, Conjunctive use, Surface-groundwater relationships, Water wells, Aquifers, Alluvium, Limestones, Basalts, Water levels, Water yield, Transmissivity, Streamflow, Irrigation water, Water utilization, Water quality, Safe yield.
Identifiers: Big Lost River basin (Idaho).

The Big Lost River basin occupies about 1,400 square miles in south-central Idaho and drains to the Snake River plain. The economy in the area is based on irrigation agriculture and stockraising. The principal aquifer is unconsolidated alluvial fill that is several thousand feet thick in the main valley. Carbonate rocks are the major bedrock aquifer. Only the alluvium, carbonate rock and locally the basalt yield significant amounts of water. Average annual precipitation ranged from 8 inches on the valley floor to about 50 inches at some higher elevations during the base period 1944-68. The estimated water yield of the Big Lost River basin averaged 650 cfs for the base period. A distinctive feature of the Big Lost River basin is the large interchange of water from surface streams into the ground and from the ground into the surface streams. The estimated 425 cfs that leaves the basin as groundwater flow is more than adequate for present and foreseeable needs. Both the surface and groundwaters are of good quality and are suitable for most uses. Although these waters are low in total dissolved solids, they tend to be hard or very hard. (Knapp-USGS)
W70-06529

WATER REPELLENCY AND INFILTRATION RESISTANCE OF ORGANIC-FILM-COATED SOILS,
Agricultural Research Service, Phoenix, Ariz. Water Conservation. Lab.
D. H. Fink.
Soil Science Society of America Proceedings, Vol 34, No 2, p 189-194, March-April 1970. 6 p, 7 fig, 2 tab, 18 ref.

Descriptors: *Water yield improvement, *Wettability, *Infiltration, *Films, *Soil water movement, Organic compounds, Coatings, Monomolecular films, Moisture tension, Surface tension, Soil physical properties, Soil chemical properties, Porosity.
Identifiers: Water repellent soils.

Water repellency and infiltration resistance of porous soils coated with a variety of thin, organic films were examined. The effective contact angle of water on these treated soils was found to be a function of (1) the structure of the hydrophobic portion of the organic admolecules, and (2) the proportion of soil surface covered with the organic film, but was relatively independent of soil chemical and physical properties. Effective angles as high as 150 to 160 deg were recorded for several types of organic materials. These included several silcone water repellents, an amine- and a hydroxy-substituted phenol, and an acetic acid salt of a long-chain fatty amine. The breakthrough pressure was directly affected by the factors that controlled the contact angle, and was inversely related to the effective pore radii of the porous, water-repellent soils. (Knapp-USGS)
W70-06531

WATER SUPPLIES FOR ARID REGIONS.
American Association for the Advancement of Science, Washington, D.C.

Edited by J Linton Gardner and Lloyd E Myers. Contribution No 10 of The Committee on Desert and Arid Zones Research Southwestern and Rocky Mountain Division, A.A.A.S., Symposium held May 1-2, 1967, the Univ of Arizona, Tucson, 1967.

Descriptors: *Water conservation, *Water utilization, *Water yield improvement, Water conveyance, Water consumption, *Water harvesting, Weather modification, Cloud seeding, Water storage, Evaporation control, Water transfer, Irrigation water, Saline water, Seepage control, *Arid lands, Arid climates.

Water supply problems in arid regions cannot be solved unless all aspects of the problems are given proper consideration. Obtaining additional water by importation, desalination, cloud seeding, or increasing precipitation runoff from watersheds is necessary but not sufficient. Attention must also be paid to water pollution, alternative water uses, reuse of water, and the accumulation of salt in groundwater and soils. These problems are particu-

larly acute in arid regions where water supplies are limited and harmful salts and wastes are not removed by an outflow of water from the regions. Some of these problems are discussed in the following papers of this Symposium. (See also W70-06678 thru W70-06683).
W70-06677

PROJECT SKYWATER,
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.
J. Robert Stinson.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 10-22, 1967.

Descriptors: *Cloud seeding, *Weather modification, *Precipitation (Atmospheric), *Artificial precipitation, *Silver iodide, Rainfall, Snow, Clouds, Colorado River Basin, Great Basin, Pacific Northwest U.S., Missouri River, Rio Grande, Semiarid climates, Climatic data, Laboratory tests, Meteorology, On-site-investigations.
Identifiers: *Project Skywater.

Project Skywater is a government program mainly concerned with cloud treatment. This treatment is generally accomplished by seeding with AgI. The project is concentrating on such problems as the amount and type of seeding material used and the amount and location of the resulting precipitation. The results of extensive laboratory studies are outlined. Field studies in the Colorado River Basin, Missouri River Basin, Rio Grande River Basin, Great Basin, Pacific Northwest, and southern Sierra Nevada Mountains are also discussed. (See also W70-06677). (Carr-Arizona)
W70-06678

PRECIPITATION RUNOFF INDUCEMENT,
Agricultural Research Service, Phoenix, Ariz. Water Conservation Lab.
Lloyd E. Myers.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 22-30, 1967. 16 ref.

Descriptors: *Runoff, *Water harvesting, *Water conservation, *Arid lands, *Semiarid climates, Watershed management, Land use, Streamflow, Precipitation (Atmospheric), Brush control, Soil treatment, Water yield improvement, Vegetation effects, Soil treatment, Soil sealants, Soil surfaces, Asphalt, Multiple-purpose projects, Watersheds (Basins).
Identifiers: Vegetation management.

Large quantities of water are potentially available in arid and semiarid regions of the United States. Since useable streamflow is only approximately 2% of the total rainfall, part of the remaining 98% which does not go into streamflow can be harvested. A variety of water harvesting methods are being developed, including vegetation management, chemical soil treatment, and use of ground covers. Harvesting should be a benefit to other land uses and should not conflict with recreation, timber production, and grazing. It can be used in conjunction with other conservation practices to relieve the water shortage problem of the arid lands. (See also W70-06677). (Carr-Arizona)
W70-06679

WATER STORAGE,
Agricultural Research Service, Logan, Utah. Soil and Water Conservation Research Div.; and Utah Agricultural Experiment Station, Logan.
C. W. Lauritzen.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 31-37, 1967. 11 ref.

Descriptors: *Water storage, *Structures, *Seepage, *Evaporation, *Evaporation control, Storage, Storage tanks, Reservoirs, Reservoir design, Reservoir leakage, Water loss, Reservoir evaporation, Hexadecanol, Arid lands, Watertight, Linings, Plastics, Soil sealants, Elastomers, Irrigation efficiency, Earth materials, Membranes, Films, Asphalt, Costs, Storage tanks.
Identifiers: *Seepage control, Covered reservoirs.

Seepage and evaporation are major water storage problems in the arid lands. Evaporation and seepage can be controlled by storing small quantities of water in sealed structures such as steel tanks or bags. For large amount of water stored in earth structures, seepage is controlled through the use of soil sealants, plastic film, and elastomeric sheeting. Evaporation on large reservoirs is lessened to some extent by restricting water surface area and applying hexadecanol. Floating covers are also being tested, but there is presently no practical economic method for evaporation control on large water bodies. (See also W70-06677). (Carr-Arizona)
W70-06680

THE LONG DRINK: WATER CONVEYANCE IN NATURAL AND ARTIFICIAL CHANNELS,
H. Shipley.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on desert and Arid Zones Research, Contribution No 10, p 38-44, 1967. 3 fig.

Descriptors: *Water conveyance, *Arizona, *River flow, *Irrigation, *Watershed management, Watersheds (Basins), Precipitation (Atmospheric), Runoff, Water reuse, Water storage, Overdraft, Recharge, Water conservation, Arid lands, Intermittent streams, Irrigation efficiency, Municipal water, Water yield improvement.
Identifiers: *Salt River Project, *Salt River Valley Water Users' Association.

The author discusses the facets of water management and delivery in the Salt River Project System of Arizona. Among the questions considered are irregular flow of the Salt and Verde Rivers, decline in average annual rainfall in the Salt River Project watersheds, decreasing runoff, and watershed management to combat the runoff problem. Other areas covered include water conservation techniques, water supply augmentation, urban water use, and water reuse. (See also W70-06677). (Carr-Arizona)
W70-06681

WATER QUALITY PROBLEMS PECULIAR TO ARID REGIONS,
New Mexico State Univ., University Park. Dept. of Soil Chemistry.
H. E. Dregne.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A. A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research, Contribution No 10, p 45-53, 1967. 13 tab.

Descriptors: *Salinity, *Impaired water quality, *Water quality, *Water pollution sources, *Arid lands, Semiarid climates, Irrigation, Hardness (Water), Fluorine, Fluorides, Boron, Salts, Turbidity, Water temperature, Sewage effluents, Mine wastes, Oil wastes, Brine disposal, Potable water, Irrigation water, Municipal water, Industrial water.

Water quality problems of arid regions are similar to those of humid regions in kind but not in magnitude. Hardness, fluorine tolerance, boron, salinity, turbidity, and temperature are all greater problems in arid lands. Oil field wastes, mine wastes, sewage effluent, and nutrient content are other water quality problems that are accentuated in arid regions. Oil field and mine wastes are aird lands problems due to the fact that most such mining is concentrated in the arid western regions of the U.S. (See also W70-06677). (Carr-Arizona)
W70-06682

THE SALINITY PROBLEM IN REUSE OF WATER,
Utah Water Research Lab., Logan.
Jay M. Bagley.
In: J. L. Gardner and L. E. Myers, eds., Water Supplies for Arid Regions, A.A.A.S., Southwestern and Rocky Mountain Division, Committee on Desert and Arid Zones Research Contribution No 10, p 54-62, 1967. 11 ref.

Descriptors: *Water reuse, *Salinity, *Saline water, *Salts, *Water quality, Colorado River Basin, Impaired water quality, Irrigation, Irrigation water, Streamflow, Water pollution sources, River basins, Municipal wastes, Industrial wastes, Waste disposal, Arid lands, Salt balance, Mineralogy, Return flow, Interstate compacts, Waste water (Pollution).
Identifiers: Recycling, Mineral content.

If water is to be reused, provision must be made for its reconditioning. Unfortunately, mineral salts can pass through a treatment process practically unchanged and built up salinity could seriously limit increasing water reuse. The problems of reuse and salinity are considered in the context of river basins, municipalities, industry, and irrigation, with particular emphasis on the Colorado River system. Establishment of salinity concentration limits, better regulation of natural streamflow and waste discharge, and other techniques to reduce salinity are discussed. (See also W70-06677). (Carr-Arizona)
W70-06683

PROJECT SKYWATER, 1969 ANNUAL REPORT.
Bureau of Reclamation, Denver, Colo. Office of Atmospheric Water Resources.

Report No. REC-OCE-70-13, March 1970. 511 p.

Descriptors: *Weather modification, *Cloud seeding, *Precipitation (Atmospheric), *Artificial precipitation, *Silver Iodide, Climatology, Cloud physics, Model studies, Colorado River Basin, Ecology, Water Resources development, Radar, Statistical methods, Great Plains, Instrumentation.

The report represents the fiscal year 1969 activities and accomplishments of the Bureau of Reclamation's Atmospheric Water Resources Program. The objective of this weather modification program is to provide precipitation management technology for use involving the Nation's water resources problems. A short introductory section summarizes activities in the categories of winter field programs, summer field programs, nonfield programs, and pilot projects. The bulk of the document consists of reports prepared by Bureau of Reclamation contractors in which they summarize their FY 69 activities.
W70-06703

3C. Use of Water of Impaired Quality

GROUNDWATER SUPPLY OF CAPE HATTERAS NATIONAL SEASHORE RECREATIONAL AREA, NORTH CAROLINA - PART 6,
Geological Survey, Raleigh, N.C.
For primary bibliographic entry see Field 04B.
W70-06399

THE SALINITY PROBLEM IN REUSE OF WATER,
Utah Water Research Lab., Logan.
For primary bibliographic entry see Field 03B.
W70-06683

3D. Conservation in Domestic and Municipal Use

CITY OF BAYONNE V WATER SUPPLY COMM'N (DECLARATORY JUDGMENT REGARDING WATER SUPPLY CONTRACTS BETWEEN WATER COMMISSION AND MUNICIPALITY).

30 N J Super 409, 105 A2d 19-26 (N J Super Ct 1954).

Descriptors: *New Jersey, *Cities, *Administrative agencies, *Water supply, Water costs, Water rates, Judicial decisions, Legal aspects, Regulation, Control, Water resources, Reservoirs, State governments, Local governments, Water works, Legislation, Dams, Structures, Water distribution (Applied), Water demand, Water delivery, Utilities, Distribution, Domestic water, Municipal water.

Plaintiff city brought suit for a declaratory judgment seeking a construction of a New Jersey statute which provided that defendant water supply commission may contract with a municipality for the supply of water in consideration for an equitable share of the cost of constructing and operating such a supply plant. The court held that the statute required defendant to supply water to plaintiff if an adequate supply existed. The state is under a duty to control and conserve its water resources for the benefit of all its inhabitants, and it was for this reason that the defendant commission was created. Defendant is required to hold its water supply plants in trust for the municipalities. Plaintiff could not be denied access to unused water because the needs of prior contracting municipalities might increase in the future. An equitable share of the cost for such supply was reached following a study of pertinent facts. (Barnett-Florida)
W70-06715

MEMPHIS POWER AND LIGHT CO V CITY OF MEMPHIS (CITY'S CONTROL OF PUBLIC UTILITIES).
112 SW2d 817-825 (Tenn 1937).

Descriptors: *Tennessee, *Tennessee Valley Authority Project, *Power marketing, *Water supply, Public utilities, Municipal water, Cities, Economics, Federal government, Electric power, Water distribution (Applied), Contracts, Electric power costs, Monopoly, Electric power rates, Judicial decisions, Administrative agencies.

Plaintiff electric company sought an injunction to prevent the city of Memphis from proceeding under contracts with the Tennessee Valley Authority and the Federal Public Works Administration. The city contended the contracts in question created a monopoly in violation of the State Constitution. The Supreme Court of Tennessee stated that no exclusive right to distribute electricity was conferred upon the city. Also, an exclusive franchise to furnish water or light in a particular city did not constitute a monopoly. (Hubener-Florida)
W70-06721

WILLIS V WILKINS (BENEFICIAL USE OF RIPARIAN LAND MUST BE CONSIDERED BY PUBLIC AGENCIES).
32 A2d 321-324 (N H 1943).

Descriptors: *New Hampshire, *Public health, *Riparian rights, *Beneficial use, Lakes, Lake ice, Judicial decisions, Water law, Bacteria, Aquatic bacteria, Coliforms, Water pollution sources, Swimming, Local governments, State governments, Administrative agencies, Pond, Relative rights, Regulation, Abatement, Inspection, Administrative decisions, Property values.

Plaintiffs, riparian owners, sought judicial review of a State Board of Health ruling prohibiting further swimming in a lake which served as a municipal water supply. The trial court upheld the ruling as necessary to protect public health. The appellate court held that plaintiffs, as riparian owners, possessed rights in the enjoyment of the pond greater than those of members of the general public. The court stated that the importance of the public benefit must be balanced against the seriousness of the rights restricted. Since the trial court failed to take into account the decrease in property value caused by the ruling in comparison with the cost of restructuring the city water intake system and purifying the water, the cause was reversed, and a new trial was ordered. (Hubener-Florida)
W70-06723

3F. Conservation in Agriculture

EVALUATION OF EFFICIENCY IN ALLOCATING CONTRACT RESEARCH FUNDS BY THE COLORADO WATER CONSERVATION BOARD,
Colorado State Univ., Fort Collins. Dept. of Economics.
For primary bibliographic entry see Field 06C.
W70-06452

04. WATER QUANTITY MANAGEMENT AND CONTROL

4A. Control of Water on the Surface

ENVIRONMENTAL AND TECHNICAL FACTORS FOR OPEN DRAINAGE CHANNELS IN MILWAUKEE,
American Society of Civil Engineers, New York.
Ted B. Prawdzik.
Available from the Clearinghouse as PB-191 710, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 12, Urban Water Resources Research Program, February 1970. 37 p, 10 fig. OWRR Project C-1536, Contract 14-01-0001-1992.

Descriptors: *Storm drains, *Flood control, *Channel improvement, *Wisconsin, *Urbanization, Open channels, Flood protection, Storm runoff, Drainage systems.
Identifiers: *Milwaukee (Wis).

Some of the environmental and technical factors which influenced the adoption of open channels for drainage in Milwaukee are outlined. Criteria are given for the selection of channel cross-sections when the improvement of existing watercourses traversing the city was essential to ameliorate flooding. The principles discussed have been applied generally in Milwaukee. The experiences the city has had with originally natural watercourses which have been improved as open storm-drain channels are discussed. (Knapp-USGS)
W70-06318

FLOOD PLAIN INFORMATION OF CUMBERLAND RIVER, POOR, CLOVER, AND MARTINS FORKS, AND CATRON CREEK, HARLAN, KENTUCKY.
Army Corps of Engineers, Nashville, Tenn.

Corps Engineers Flood Plain Report, August 1969. 57 p, 14 fig, 16 plate, 8 tab.

Descriptors: *Floods, *Flood damage, *Kentucky, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Harlan (Ky), Cumberland River (Ky), Standard project flood, Intermediate regional flood.

Flooding of the Cumberland River and tributaries, Harlan, Kentucky is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06328

FLOOD HAZARD INFORMATION, SANTA CRUZ RIVER, SANTA CRUZ COUNTY, ARIZONA.
Corps of Engineers, Los Angeles, Calif.

Corps of Engineers Flood Plain Report, November 1969. 14 p, 4 fig, 20 plate, 3 tab.

Descriptors: *Floods, *Flood damage, *Arizona, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: *Santa Cruz River (Ariz), Standard project flood, Intermediate regional flood.

Flooding of the Santa Cruz River, Arizona is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06347

FLOOD PLAIN INFORMATION, ANAHOLA, KAUAI, HAWAII.
Corps of Engineers, Honolulu, Hawaii.

Corps Engineers Flood Plain Report, November 1969. 21 p, 3 fig, 3 plate.

Descriptors: *Floods, *Flood damage, *Hawaii, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Tsunamis.
Identifiers: Kauai (Hawaii), Standard project flood, Intermediate regional flood.

Flooding of Anaholoa, Kauai, Hawaii is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06348

FLOOD PLAIN INFORMATION, NORTH BRANCH BIG TIMBER CREEK, CAMDEN COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

Corps of Engineers Flood Plain Report, March 1969. 49 p, 3 fig, 11 plate, 12 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Camden County (N J), Standard project flood, Intermediate regional flood.

Flooding of North Branch Big Timber Creek, Camden County, New Jersey is described in a report of flood plain problems based on records of rainfall,

runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06359

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 05G.
W70-06406

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
University of Southern Mississippi, Hattiesburg.
For primary bibliographic entry see Field 06B.
W70-06411

THEORY OF WATER WAVES GENERATED BY A TIME-DEPENDENT BOUNDARY DISPLACEMENT,
California Univ., Berkeley. Hydraulic Engineering Lab.
For primary bibliographic entry see Field 02H.
W70-06456

HYDRAULIC EFFICIENCY AND SPACING OF BRITISH STANDARD ROAD GULLEYS,
Road Research Lab., Crowthorne (England).
K. Russam.
Available from the Clearinghouse as PB-188 047, $3.00 in paper copy, $0.65 in microfiche. 1969, 40 p. RRL-LR277.

Descriptors: *Drainage systems, Culverts, *Road construction.

The specification for British Standard gulley gratings, B.S.497, was revised in 1967. Measurements of the hydraulic efficiency of these gratings were made on a tilting platform which simulated a curbed road surface and which permitted the flow of water to the gulley to be varied by changes in the width of flow, the crossfall, and the longitudinal gradient. These efficiencies are given in the report. Consideration is also given to rainfall intensities and durations in the United Kingdom and a method for the design of spacing of gulleys is suggested based on the hydraulic efficiency of the gulleys and on tolerable widths of flow of water at the dege of the road.
W70-06457

LEVEE DISTRICTS (RECLAMATION PLANS).
Mo Ann Stat secs 245.140 thru 245.170 (1959).

Descriptors: *Missouri, *Land reclamation, *Levees, *Administrative agencies, Legal aspects, Legislation benefits, Damages, Planning, Assessments, Land appraisal, Construction, Embankments, Compensation, Costs, Right-of-way, Land tenure, Employment, Equipment, Specifications, Construction materials, Adjudication procedures.
Identifiers: *Levee districts.

The board of Supervisors of any levee district or owners of lands adjacent to such districts may petition the court organizing the district to correct any errors of incorporation and may petition for changes in the plan for reclamation. Where changes in the plan for reclamation are requested, the petition shall ask the court to either appoint three commissioners to appraise lands taken for the district, or assess benefits and damages to lands and changes in the reclamation plan. Procedures are outlined for court hearings on change petitions. Before a board may enter or appropriate any land for a levee district, damages as appraised shall be paid to the owner of the land. After payment, the title, use, possession, and enjoyment of such property shall be vested in the districts. Boards shall have full power and authority to build and complete all works which may be needed to carry out the plan for reclamation. Boards shall employ an attorney for the district, keep records of proceedings, and provide for compensation of employees and fees of officers. Standards of operation for boards are outlined. (Duss-Florida)
W70-06458

LEVEE DISTRICTS (ORGANIZED BY CIRCUIT COURT).

Mo Ann Stat secs 245.010 thru 245.025 (1959), as amended, (Supp 1970).

Descriptors: *Missouri, *Levees, *Bank protection, *Wetlands, Dikes, Surface runoff, Flow control, Reclamation, Swamps, Overflow, Rivers, Streams, Legislation, Bank erosion, Land, Land tenure, Public health, Assessments, Taxes, Navigable waters, Federal government, Legal aspects, State governments, Cities, Erosion control.
Identifiers: *Levee districts.

The term 'levee district' refers to districts organized for the purposes of constructing levees, dikes, bank protections, current control or other protections contiguous or adjacent to lands which are subject to overflow and inundation. The lands must be wholly within or bordering the state of Missouri. Provisions outline the formation of districts in smaller cities and rural areas. 'Owner' means the owner of the freehold estate and excludes reversioners, remaindermen, trustees or mortgagees. The owners of a majority of acreage in any contiguous body of swamp, wet, or overflowed land, or land subject to overflow, wash or bank erosion, may form a levee district to protect such lands from these effects. Articles of association shall be filed with the clerk of the circuit court. If any work is to be done on a navigable stream, consent of the federal government must be obtained. The clerk of the circuit court shall give notice of the filing of articles by publication. Any owner within the proposed district may file objections which shall be heard by the court. Assessments and taxation provisions are included. (Duss-Florida)
W70-06468

HOKE V CITY OF GREENSBURG (MUNICIPAL LIABILITY FOR DIVERSION OF SURFACE WATER THROUGH STORM SEWER).

42 Westmoreland County Law Journal, Vol. 42, p. 225-229 (Pa Ct C P 1959).

Descriptors: *Pennsylvania, *Surface drainage, *Diversion, *Stormdrains, Sewers, Legal aspects, Judicial decisions, Channels, Damages, Drainage systems, Cities, Surface water, Conveyance structures, Reasonable use, Relative rights, Drainage effects, Water conveyance, Flooding, Artificial watercourses.

The defendant City of Greensburg installed a 14 inch storm sewer that extended along the westerly edge of a city street in a southerly direction. The storm sewer was then extended in a westerly direction to a 48 inch storm sewer which passed in a general southerly direction to real estate owned by plaintiffs. Plaintiffs filed a suit to recover for damages resulting to their property when defendant diverted surface water through the system onto plaintiffs' land. The jury returned a verdict for the plaintiffs and the defendants moved for a new trial. On appeal, the court held that the determination of defendant's liability was properly left to the jury. (Powell-Florida)
W70-06469

GIOVITTO V NASSAU COUNTY (OVERFLOW OF MUNICIPAL DRAINAGE SYSTEM).
63 NYS 2d 864-866 (1946).

Descriptors: *New York, *Drainage systems, *Obstruction to flow, *Flood damage, Embankments, Retaining walls, Surface runoff, Land use, Flood protection, Drains, Railroads, Local governments, Legal aspects, Judicial decisions, Ditches, Developed waters, Flood control, Damages, Relative rights, Discharge (Water).

Plaintiff brought action against Nassau county and the Long Island Railroad Company for damages and injunctive relief to prevent further flooding of his land. Defendant county had constructed a drainage system which collected surface waters and discharged them onto plaintiff's land. The court held that the county could not, by means of ditches or drains, collect surface water into a single stream and discharge it upon another's land. The railroad, whose large embankment caused water to back up on one side, was not liable to plaintiff since a lower proprietor may protect his property from surface water even to the extent of throwing the water back upon the land of the adjoining proprietor. A lower proprietor must only refrain from collecting and discharging the water upon adjoining premises. (Hubener-Florida)
W70-06472

PERNELL V CITY OF HENDERSON (ACTION AGAINST MUNICIPALITY FOR THE UNREASONABLE DIVERSION OF WATER TO THE HARM OF RIPARIAN OWNERS).
220 N C 79, 16 SE2d 449-451 (NC 1941).

Descriptors: *North Carolina, *Riparian rights, *Competing uses, *Reasonable use, Riparian waters, Cities, Alteration of flow, Dams, Reservoirs, Diversion, Water management (Applied), Natural flow doctrine, Prior appropriation, Relative rights, Streamflow, Water utilization, Diversion dams, Downstream, Water pollution, Legal aspects, Judical decisions, Damages, Remedies.

Plaintiff alleged that defendant city's operation of a dam and reservior on the stream above his mill had diverted the stream from its natural channel. This diversion was alleged to have diminished the value of plaintiff's mill site. Secondly, plaintiff sought damages for defendant's disposal of sewage into the stream which had polluted such stream and created a nuisance that caused injury to his business. Defendant argued that as a municipality it had the right to divert water for domestic purposes as a riparian owner as long as the use was reasonable. The court found the controlling rule to be that a political unit could not be a riparian owner and as such claim the right to supply the needs of its inhabitants from the stream to the harm of an individual downstream owner. The flow of water in a stream is a natural property right of a riparian owner, the diversion of which is actionable in damages. It was also held that the plaintiff could establish as actionable the injury which he had sustained because of the maintenance of the nuisance. (Barnett-Florida)
W70-06474

MULLINS V MORGAN (INJUNCTION AGAINST BUILDING WALL OUT INTO CHANNEL OF STREAM).
10 SE2d 593-598 (Va 1940).

Descriptors: *Virginia, *Barriers, *Obstruction to flow, *Streams, Alteration of flow, Diversion, Remedies, Structures, Floods, Abatement, Damages, Legal aspects, Judicial decisions, Flow around objects, Deflection, Flow, Construction, Channels, Channel flow, Riparian land, Relative rights.

The plaintiffs sought an injunction against further construction of a building which extended out a considerable distance into the channel of a creek and sought removal of a wall already constructed.

There was evidence that the wall extended 11 feet out into the channel, some one-seventh of the channel's width, and diverted the flow of water so as to expose plaintiffs to the danger of flood in time of high water. The court held that plaintiffs did not need to wait until damage actually occurred to their property, but could seek injunctive relief to forestall injury. The wall constituted a private nuisance, the court held, and could be abated by injunction. The fact that plaintiffs had waited until the wall was finished before bringing the action was held not to constitute laches barring relief, and a lower court decision for the defendants was reversed. (Caldwell-Florida)
W70-06491

JONES V CHICAGO, B AND O (LIABILITY FOR NEGLIGENT CONSTRUCTION OF EMBANKMENT).
100 SW2d 617-635 (St. Louis Ct App Mo 1937).

Descriptors: *Missouri, *Flood damage, *Railroads, *Natural streams, Embankments, Bridges, Overflow, Water spreading, Disasters, Levees, Legal aspects, Drainage districts, Water law, Watercourses (Legal), Intermittent streams, Channels, Obstruction to flow, Rivers, Mississippi River, Surface waters, Tributaries, River flow, Rainfall.
Identifiers: *Slough.

Plaintiff brought action against the railroad company for flood damage to plaintiff's crops caused by the negligent construction of an embankment. Plaintiff claimed the embankment blocked the flow of water in nearby watercourse thereby causing an overflow onto plaintiff's land during a severe rainstorm. From a jury verdict for plaintiff, defendant appealed. The court of appeals held that the evidence was insufficient for submission to the jury on the question of railroad's negligence. The court found that the facts proved it impossible for the backed up water to have destroyed plaintiff's crops. The court further found that a depression or slough over which the embankment was built was not a 'watercourse.' A watercourse must have a definite channel, defined banks and bed, and frequent, though not continued flow. Since there was no watercourse, defendant was not liable for building an embankment over a mere depression. In conclusion the court stated that the plaintiff failed to show a causal connection between the alleged acts of negligence by the railroad and the damage to his crops. (Hubener-Florida)
W70-06495

CHESAPEAKE AND ORY V CAUDILL (FLOOD DAMAGES FROM ALLEGED NEGLIGENT CONSTRUCTION AND REPAIR OF TRESTLE).

109 SW2d 20-25 (Ky 1937).

Descriptors: *Kentucky, *Damages, *Flood damage, *Bridge construction, Judicial decisions, Floods, Bridges, Bridge design, Railroads, Repairing, Stream flow, Streams, Construction, Legal aspects, Structures, Flood waters, Flow, Obstruction to flow, Structural members, Alternation of flow, Maintenance, Overflow.
Identifiers: *Temporary damages.

Plaintiff alleged damage to his property caused by stream overflow resulting from defendant railroad company's negligent construction and repair of its trestle. Damages were sought on the theory that careless repair of the pilings had caused the stream to back up onto plaintiff's property. Defendant denied negligence, claiming that the trestle was a permanent structure rather than a temporary one thus reducing the amount of possible recovery and alleging that the damage was caused by an extra-ordinary flood. In reversing an award for 'temporary damages', the court held that any careless repair of the trestle pilings was a temporary condition, and that there was no evidence adduced supporting an award of damages for temporary conditions. All of the plaintiff's proof had gone toward showing permanent damages. Where improper repair of a bridge causes a backup of floodwaters onto private property, the damages are temporary and recurring recoveries may be obtained. These recoveries must, however, be supported by proper proof, and cannot be satisfied by evidence of permanent damages. (Caldwell-Florida)
W70-06497

PRIVATE DRAINAGE RIGHTS.

Mo Ann Stat secs 244.010 thru 244.130 (1959)

Descriptors: *Missouri, *Surface drainage, *Relative rights, *Riddance (Legal aspects), Swamps, Judicial decisions, Land tenure, Drainage, Ditches, Levees, Construction, Wetlands, Bayous, Outlets, Costs damages, Benefits, Cost allocation, Compensation, Tile drains, Sanitary engineering, Agricultural engineering, Legislation, Legal aspects.

Owners of swamp, wet, flat, or overflowed lands may drain or protect such lands for sanitary or agricultural purposes by constructing ditches, tile drains, or levees. Such works may be constructed across intervening parcels of land in order to effect drainage into nearby waters. Compensation must be paid to owners of affected lands. This chapter outlines the relative rights of landowners before and after construction and sets forth the procedures for resolving disagreements over methods of drainage and construction. The circuit court shall have jurisdiction over such matters, shall entertain petitions for, and objections to, improvements and shall apportion the costs thereof. Appeal procedures are provided. Persons desiring to protect or drain land shall not be limited to a single ditch, tile, or levee. However, the benefits of the improvements must exceed any resultant damage. Persons interfering willfully with the usefulness of any ditch, tile or levee shall be guilty of a misdemeanor. Owners of land desired to be drained have the right to inspect, without the owner's consent, lands through which the improvements are to be built. (Duss-Florida)
W70-06505

McRAE V CAMDEN AND ROCKLAND WATER CO (ARTIFICIAL DRAINAGE ONTO ANOTHER'S LAND).
22 A 2d 133-135 (Me 1941).

Descriptors: *Maine, *Tile drainage, *Flood damage, Excess water, Tiles, Boundaries (Property), Controlled drainage, Drainage effects, Discharge (Water), Drainage systems, Drainage water, Seepage, Gravitational water, Subsurface drainage, Pipes, Flooding, Legal aspects, Judicial decisions, Relative rights, Damages.
Identifiers: *Prescription.

Defendant water company built and maintained a valve house over a surface water collection pit located drain on its own land. It built a 150 foot tile drainage pipe from the collection pit which emptied into a rock located on plaintiff's golf course. For unknown reasons the tile drain broke, and the break in the tile caused the rock drain to become stopped up. As a result, the water backed up and flooded large areas of plaintiff's fairways. The flooding continued even after defendant repaired the tile drain. Plaintiff brought action for damages. The court found no indication that defendant had a right through grant, prescription or otherwise to establish and maintain the tile drain on plaintiff's land. It held that no person may artificially collect water on his own land and discharge it on his neighbor's property upon which it would not have naturally fallen. If he does so, he is liable for the resulting damages. (Clarke-Florida)
W70-06506

GEOHYDROLOGY OF THE CROSS-FLORIDA BARGE CANAL AREA WITH SPECIAL REFERENCE TO THE OCALA VICINITY,
Geological Survey, Tallahassee, Fla.
Glen L. Faulkner.
Geological Survey Open-file Report, January 1970. 222 p, 35 fig, 3 tab, 66 ref.

Descriptors: *Hydrogeology, *Florida, *Canals, *Canal seepage, Transportation, Water pollution sources, Groundwater movement, Canal design, Springs, Aquifers, Limestones, Karst, Water supply.
Identifiers: Cross-Florida Barge Canal.

The Cross-Florida Barge Canal route commences at Palatka on the St. Johns River, and extends across Peninsular Florida into the Gulf of Mexico near Yankeetown. From near Ocala northeastward, the canal channel will replace much of the natural channel of the Oklawaha River, and will be excavated into the shallow sand aquifer of Miocene and younger age, which overlies limestone of the Floridan aquifer. Westward from Ocala most of the canal will be excavated below the potentiometric surface into limestone and dolomite of the Floridan aquifer. Only principal rivers, such as the Oklawaha and Withlacoochee Rivers, and a few short tributaries flow, while one of the most highly developed subsurface drainage systems in the world has evolved in the cavernous limestones of the Floridan aquifer. Two of the larger fresh-water springs in the world now discharge from the Floridan aquifer in the canal area. The greatest potential for adverse effects on the ground-water regime exists in the area of the Summit Pool. The canal channel will be excavated into limestone of the Floridan aquifer to depths of 12 to 27 feet below the potentiometric surface. It is particularly important in the Summit Pool to use good construction and operation, to minimize risks of groundwater contamination. (Knapp-USGS)
W70-06534

A DAM ACROSS THE AMAZON,
Hudson Inst., Inc., Croton-on-Hudson, N.Y.
Robert B. Panero.
Science Journal, Vol 5A, No 3, p 56-60, September 1969. 5 p, 2 fig, 1 photo, 3 ref.

Descriptors: *Dams, *Reservoirs, *Planning, *Water resources development, *Feasibility studies, Multiple-purpose projects, Project planning.
Identifiers: Amazon River.

A dam is proposed for the Amazon River. An inland Amazon Sea connected to a network of Great Lakes could be created by damming the Amazon and its tributaries. The project would open up a development area the size of the United States and provide unprecedented quantities of hydroelectricity. If damming the Amazon mainstream is possible it should be in the area between Monte Alegre and Obidos where the natural narrows occurs. The dam would be relatively easy to build for three specific reasons: the foundation is essentially compacted sand and gravel; there is no record of earthquakes in the zone; and all required construction materials are available in the vicinity. The cost of such a dam, 25 m high and 65 km long, is about $800 million. (Knapp-USGS)
W70-06538

MALVERN GRAVEL CO V McMILLAN (WHETHER OPERATIONS OF UPSTREAM GRAVEL COMPANY CAUSED DIVERSION OF FLOOD WATERS ONTO PLAINTIFF'S PROPERTY).

139 SW2d 390-394 (Ark 1940).

Descriptors: *Arkansas, *Obstruction to flow, *Natural flow doctrine, *Flood damage, Damages, Diversion, Reasonable use, Remedies, Judicial decisions, Land use, Riparian rights, Floods, Overflow, Floodwaters, Levees, Canals, Channel flow, Rivers, Sedimentation, Structures, Alteration of flow, Relative rights, Legal aspects, Banks, Gravels.

Plaintiff landowner claimed that defendant's upstream gravel mining operations, which allegedly damaged levees and embankments, diverted flood-

waters onto plaintiff's land. Gravel was also allegedly washed onto the land causing extensive damage. The court agreed that a riparian owner is entitled to have the stream flow in its natural and customary course without obstruction, and that any diversion causing injury is actionable. No evidence was found, however, which showed any damage to banks or levees beyond that left by an earlier flood in 1927. The evidence pointed to the fact that any lowering of the bank level, which contributed to the flooding of plaintiff's land, was due to the earlier flood damage and not to defendants' operations. (Caldwell-Florida)
W70-06541

FLOOD PLAIN INFORMATION, LITTLE TIMBER CREEK, CAMDEN COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.

Prepared for Camden County Planning Board and N J Dept of Conserv and Econ Development. Corps Engineers Flood Plain Report, March 1969. 49 p, 3 fig, 11 plate, 10 tab.

Descriptors: *Floods, *Flood damage, *New Jersey, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood, Historic flood.
Identifiers: Camden County (NJ), Standard project flood, Intermediate regional flood.

Flooding of Little Timber Creek, Camden County, New Jersey is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06543

POSSIBILITIES OF BIOLOGICAL CONTROL OF AQUATIC WEEDS IN INDIA.
Commonwealth Inst. of Biological Control, Bangalore (India).

Water Resources Journal, United Nations Economic Commission for Asia and the Far East (ECAFE), p 40-50, September 1969. 11 p, 29 ref.

Descriptors: *Aquatic weeds, *Biocontrol, Integrated control measures, Water resources development.
Identifiers: *India.

A large number of aquatic weeds occur in Indian inland waters, including lakes, tanks, ponds, irrigation channels and cultivated areas temporarily covered by water, such as rice and jute fields. Their harmful nature is due to the fact that they may pollute drinking water when they die and decay, provide convenient breeding sites for mosquitoes and, by invading large areas and occurring in dense stands, impede the free movement and use of water in irrigation systems and interfere with fish culture and growing crops, such as rice and jute. In most parts of India mechanical control measures are adopted where they are absolutely necessary, as in the case of irrigation channels, and large sums of money are spent annually for this purpose. There is very little money available for chemical control of aquatic weeds. Therefore, aquatic weed control in India may well be attempted by non-chemical methods, such as mechanical and biological methods. Though farmers may be interested in their control they would be unable or unwilling to pay for it. During the last few years, the Indian station of the Commonwealth Institute of Biological Control has been conducting a survey for natural enemies of several major and minor aquatic weeds. As a result of this survey a number of insects, fungi and other organisms associated with these weeds have been recorded, host-specificity tests conducted and their actual or potential value as biocontrol agents evaluated. (Knapp-USGS)
W70-06549

FLOOD PLAIN INFORMATION, DEKALB COUNTY, GEORGIA.
Corps of Engineers, Savannah, Ga.

Prepared for DeKalb County, Georgia. Corps Engineers Flood Plain Report, October 1968. 73 p, 39 fig, 66 plate, 18 tab.

Descriptors: *Floods, *Flood damage, *Georgia, Flood plains, Flood control, Non-structural alternatives, Maximum probable flood.
Identifiers: DeKalb County (Ga), Standard project flood, Intermediate regional flood.

Flooding of DeKalb County (Georgia) is described in a report of flood plain problems based on records of rainfall, runoff, and historical and present flood heights. Maps, photographs, profiles, and cross sections indicate the extent of flooding that has occurred and which may be expected to occur in the future. The information is for use in study and planning ways to minimize vulnerability to flood damages by control of flood plain use by zoning and subdivision regulations, the construction of flood protection works, or by combinations of these approaches. (Knapp-USGS)
W70-06568

RUTKA V RZEGOCKI (ALTERATION OF FLOW AND OBSTRUCTION CAUSED BY WALL CONSTRUCTION).

43 A 2d 658-659 (Conn 1945).

Descriptors: *Connecticut, *Flooding, *Walls, *Alteration of flow, Land use, Boundaries (Property), Discharge (Water), Legal aspects, Land development, Embankments, Slopes, Natural flow, Surface waters, Repulsion (Legal aspects), Relative rights, Obstruction to flow, Surface runoff, Judicial decisions.

Plaintiff claimed that defendant, in building a wall along their common boundary line, had affected the slope of the land so as to cause surface waters to discharge and collect on plaintiff's land. The court stated as a general rule that a landowner must not use or improve his property in such a way as to increase the total volume, or alter the natural flow, of surface water which flows onto adjoining property. Conflicting evidence had been presented as to whether the wall, together with an embankment and other changes on defendant's land, had the effect of discharging water onto plaintiff's property in a manner different in volume and course from its natural flow. The trial court's decision that plaintiff had failed to show an alteration of flow by a preponderance of the evidence was affirmed. (Caldwell-Florida)
W70-06603

ROBERTSON V ARNOLD (DIVERSION OF TRIBUTARY WATERS RESULTING IN STREAM DRAWDOWN).
186 SE 806-810 (Ga 1936).

Descriptors: *Georgia, *Riparian rights, *Tributaries, *Diversion losses, Flow, Diversion, Judicial decisions, Legal aspects, Land tenure, Riparian land, Soils, Non-navigable waters, Springs, Streams, Bodies of water, Water loss, Water supply, Watercourses, Ditches, Mills, Powerplants, Alteration of flow, Remedies, Relative rights, Drawdown.

Plaintiff was a lower riparian owner. Defendant was an upper riparian owner. Defendant diverted water from one of the tributaries feeding a non-navigable stream on plaintiff's land, and planned to divert water from another tributary. Plaintiff sought to enjoin defendant, alleging that the diversion diminished the value of his property because it reduced the flow over a water race constructed on the property. This water race made the plaintiff's land adaptable for construction of a mill or powerplant, though neither had ever been built. The trial court sustained a demurrer to the petition because it found it too speculative. The Georgia Supreme Court reversed, holding that according to law the owner of land through which non-navigable watercourses may flow is entitled to have the water come to the land in its natural and usual flow. Running water belongs to the owner of the land while it is on the land, but there is no power to divert it from its usual channel, nor interfere with the enjoyment of the next owner. (Duss-Florida)
W70-06653

CITY OF LOUISVILLE V TWAY (LOWER RIPARIAN OWNER CONTESTING DAMS ACROSS STREAM AND POLLUTION BY UPPER RIPARIANS).
180 SW2d 278-281 (Ky 1944).

Descriptors: *Kentucky, *Natural flow doctrine, *Reasonable use, *Riparian rights, Dams, Obstruction to flow, Judicial decisions, Streams, Natural watercourses, Watercourses (Legal), Diversion, Reservoirs, Riparian land, Water pollution sources, Pollution abatement, Dairy industry, Relative rights, Land use, Dam construction, Drainage water, Manure, Remedies, Cities.

Defendants were upper riparian landowners whose property was traversed by the same stream. One defendant, a dairy farmer, permitted wastes from the dairy floor and manure to enter the stream and had also constructed a large concrete dam which allegedly impeded streamflow. The other defendant had built a series of small dams to create pools in the stream and had also constructed a reservoir to capture flow from a spring to the stream. Plaintiffs, a lower riparian owner and the city of Louisville, sued to halt the pollution and the interference with the natural stream flow. The dairy farmer agreed to submit to an injunction ordering the abatement of the pollution. The other defendant agreed to remove the series of dams which created the pools. With regard to the large concrete dam and the reservoir, the appellate court affirmed the lower court's finding that there was not in either instance an unreasonable use of water since no water was utilized from these sources. The court also affirmed the finding that these structures caused no appreciable decline in the flow of water in the stream. (Dearing-Florida)
W70-06664

JOHNSON V LAINHART (CONSTRUCTION OF BARRIERS TO RESTORE LAND LOST THROUGH ACCRETION).
118 SW2d 204-208 (Ky 1938).

Descriptors: *Kentucky, *Accretion (Legal aspects), *Boundaries (Property), *Alteration of flow, Channels, Streams, Walls, Obstruction to flow, Channel flow, Riparian rights, Riparian land, Legal aspects, Judicial decisions, Bank erosion, Non-navigable waters, Bank erosion, Barriers, Boundary disputes, Streamflow, Banks, Remedies, Floods, Bank protection, Erosion control.

The channel of a non-navigable stream forming the boundary between plaintiff's and defendant's property had gradually shifted, extending by accretion plaintiff's property and causing a corresponding loss of defendant's land. The plaintiff sought to prevent defendant from building a wall in the streambed which would alter the flow of the stream so as to restore it to its old channel. The court held that defendant's stream boundary had changed with the shifting of the channel and that he had no right to attempt to restore the former channel. Although conceding that the rule was otherwise where the channel was changed rapidly, as by flood, the court found that such rule was not applicable in the instant case and enjoined defendant from building the wall out into the stream. The

court stated that defendant was entitled to build a wall along the present banks to protect his property from further erosion, but that he could not attempt to gain back property which no longer belonged to him by restoring the old channel. (Caldwell-Florida)
W70-06675

WATER STORAGE,
Agricultural Research Service, Logan, Utah. Soil and Water Conservation Research Div.; and Utah Agricultural Experiment Station, Logan.
For primary bibliographic entry see Field 03B.
W70-06680

THE LONG DRINK: WATER CONVEYANCE IN NATURAL AND ARTIFICIAL CHANNELS,
For primary bibliographic entry see Field 03B.
W70-06681

CHESAPEAKE AND O RY V SAULSBERRY (NEGLIGENT FLOODING OF RIPARIAN LANDS).

88 SW2d 949-951 (Ky 1935).

Descriptors: *Kentucky, *Railroads, *Obstruction to flow, *Bridges, Legal aspects, Riparian rights, Natural flow doctrine, Proprietary power, Relative rights, Riparian land, Watercourses (Legal), Drainage, Floods, Streamflow, Judicial decisions, Abutments, Culverts, Streams, Streamflow.

Defendant railroad had constructed a bridge over a creek. Over a period of time, sediment and other debris collected in the aperture under the bridge to such extent that during a period of heavy rains, the swollen creek was prevented from flowing freely through the aperture. This caused plaintiff's adjoining land to be flooded by the overflow. Plaintiff sought damages for defendant's negligence in failing to maintain an opening under its bridge sufficiently large to allow free passage of water from heavy rains. The court held that a lower proprietor is not required to immediately remove from a channel debris which collects around an intruding structure, but he must do so within a reasonable time. Likewise, such a proprietor has a continuing duty to exercise reasonable care in maintaining openings beneath his bridges and cluverts sufficient to allow free passage of water during normal heavy rains. Defendant breached this duty and was liable to plaintiff for damages. (Clarke-Florida)
W70-06712

JACOBSON V CAMDEN (HIGHWAY IMPROVEMENT ALLEGED TO INTERFERE WITH DRAINAGE).
20 NW2d 407-411 (Iowa 1945).

Descriptors: *Iowa, *Drainage, *Highways, *Natural flow, Ditches, Surface waters, Diversion, Obstruction to flow, Drainage water, Surface runoff, Drainage effects, Drainage engineering, Land tenure, Legal aspects, Relative rights, Damages, Remedies, Maps, Flood damage, COnstruction, Prescriptive rights, Culverts, Judicial decisions, Crops.

Plaintiff's land, which was separated from defendant's property by a road, drained naturally onto defendant's land. Plaintiff alleged that work done on the road, and defendant's filling in of a culvert, obstructed this natural drainage, caused water to back up on plaintiff's property, and caused crop damage. The court, relying on survey plats presented by plaintiff's engineer, found that the natural drainage was as alleged. The court also held that the work done on the road had obstructed the drainage in that a ditch on the side of the road permitted water to flow along the road and collect in a low point on plaintiff's property rather than continuing its natural flow onto defendant's land. The filling in of the culvert by the defendant was also wrongful. The highway authority was held to be under a duty to permit surface water to drain in its natural manner. An injunction was held to be appropriate to restrain highway officials and defendant from causing water to flow upon plaintiff's land in an unnatural manner. (Caldwell-Florida)
W70-06713

PEOPLE V RIX (COST SHARING BETWEEN STATE AND LOCAL GOVERNMENTS).
169 NW2d 132-134 (Ct App Mich 1969).

Descriptors: *Michigan, *Drains, *Cost allocation, *Administrative agencies, Administration, Regulation, Drainage systems, Judicial decisions, Legal aspects, Waste water disposal, State governments, Highways, Local governments, Equitable apportionment, Public health, Rates, Costs, Cost sharing Assessments, Drainage.

Pursuant to a state statute, a drainage board was created in Kalamazoo County. A drain was deemed necessary, and the board determined that the State Highway Commission's share of the cost of such drain was twenty percent of such cost. On appeal to the circuit court, the board's decision was affirmed. The Commission appealed, asserting that twenty percent drain assessment was arbitarary and capricious in disregard of the law and facts, and in excess of the board's jurisdiction. The appellate court affirmed stating that the administrative decision as to the amount of the assessment was not judicially reviewable unless there was evidence of fraud or bad faith present. Upon a complete hearing it was found that the board's actions fully complied with the statute and that the return made by the drain board showed a satisfactory basis for the determination made. (Barnett-Florida)
W70-06717

DUNLAP V CAROLINA POWER AND LIGHT CO (ACTION FOR DAMAGES TO ENJOIN UNREASONABLE USE OF RIPARIAN WATERS).
212 N C 814, 195 SE 43-49 (N C 1938).

Descriptors: *North Carolina, *Reasonable use, *Alteration of flow, *Dams, Competing uses, Diversion, Electric power, Natural flow doctrine, Obstruction to flow, Prior appropriation, Relative rights, Water pollution, Riparian rights, Riparian land, Riparian waters, Remedies, Legal aspects, Judicial decisions, Erosion, Banks, Streams, Rivers, Water levels.

Plaintiff owned riparian land on a non-navigable river. Defendant constructed a dam across the river upstream from plaintiff's land. Plaintiff alleged that the impounding and releasing of waters in defendant's dam operations interfered with his reasonable use of the water as a riparian landowner. The appellate court held that a riparian owner has the right to the reasonable use of the river as long as he does not pollute or divert it so as to deprive others of their riparian rights. There may be such diminution and retardation of the natural flow as is necessary to allow beneficial and reasonable use of the waters. The right to use necessarily implies a right to exercise a degree of control over the water, and to some extent, to diminish its volume. Such interruption of streamflow as is necessary and unavoidable cannot be the subject of an action. (Barnett-Florida)
W70-06718

BRUTON V CAROLINA POWER AND LIGHT CO (JUDGMENT FOR PERMANENT DAMAGES CAUSED BY DAM-CREATED FLOODING AS BAR TO SUBSEQUENT ACTION).
217 N C 1, 6 SE2d 822-830 (N C 1940).

Descriptors: *North Carolina, *Damages, *Flood damage, *Easements, Judicial decisions, Obstruction to flow, Floods, Legal aspects, Land tenure, Land use, Riparian land, Riparian rights, Condemnation, Eminent domain, Flow, Overflow, Erosion, Rainfall, Precipitation excess, Floodgates, Dams, Construction, Structures, Hydroelectric power.

Plaintiffs, lower riparian owners, brought suit against the defendant, an upper riparian owner, for floodwater damages to their property resulting from the negligent operation of defendant's hydroelectric dam. Plaintiff's testator during his lifetime had brought suit and recovered from defendant in two related actions--one for damages to agricultural crops from flooding, and one for permanent damages to his ferry operation due to defendant's obstruction to flow. In this action defendant interposed a plea of res judicata and moved for nonsuit. The trial court eventually granted this motion. The North Carolina Supreme Court affirmed. The wrong complained of by plaintiffs' testator (in one of his actions) was continuing in nature, resulting from construction and maintenance of a permanent power plant. The assessment and payment of permanent damages vested in the defendant an easement entitling him to continued use of the property in the existing manner. (Duss-Florida)
W70-06719

MITCHELL V VIRGINIA RR (ACTION FOR DAMAGES RESULTING FROM THE OBSTRUCTION OF A STREAM BY A RAILROAD BRIDGE).
183 SE 35-39 (W Va 1935).

Descriptors: *West Virginia, *Floods, *Watercourses (Legal), *Obstruction to flow, Judicial decisions, Legal aspects, Overflow, Floodwater, Flow, Railroads, Bridges, Culverts, Construction, Maintenance, Bodies of water, Streams, Rain, Riparian land, Riparian rights, Land, Land tenure.

Plaintiffs were owners of property located upstream from defendant railroad's bridge over the stream. Plaintiffs alleged, that because of insufficient clearance between the bridge and the water, timber and debris lodged against the bridge causing water to back up onto plaintiffs' property. Defendant claimed that the bridge had sufficient clearance to accommodate floodwaters that could have reasonably been anticipated, and that the floods which cuased the damage constituted 'an act of God.' From a judgement for plaintiff defendant appealed. The Supreme Court of Appeals of West Virginia affirmed, holding that it is the province of the jury to determine whether a flood is so extraordinary as to amount to an act of God. One obstructing a natural watercourse will not be excused from liability for resulting damage unless an act of God is the sole and proximate cause of the injury. Prior evidence of flooding was an important consideration in the case, and the court felt that such evidence was sufficient to support the issue of reasonable anticipation of future floods. (Duss-Florida)
W70-06720

FARRINGTON V KLAUBER (RIGHTS OF ADJOINING RIPARIAN OWNERS TO UNOBSTRUCTED FLOW).
32 A2d 644-646 (Conn 1943).

Descriptors: *Connecticut, *Dams, *Overflow, *Flow control, Obstruction to flow, Legal aspects, Riparian rights, Judicial decisions, Relative rights, Natural flow, Dam construction, Ponding, Banks, Streamflow, Water control, Watercourses (Legal), Natural flow, Spillways, Concrete structures, Legal aspects, Barriers.
Identifiers: Injunctions (Mandatory).

The defendant erected a dam across a small watercourse that flowed on his land. The plaintiff sought an injunction for the removal of the dam to restore former water level, claiming that the dam caused water to overflow on his land. The trial court found that at no time had the defendant's acts substantially raised the water level on the plaintiff's land and denied an injunction. The appellate court acknowledged the right of an adjoining landowner

to require the water to flow in the accustomed manner, but reasoned that where there is no substantial invasion of plaintiff's rights, the issuance of an injunction rests in the discretion of the trial court. (Hubener-Florida)
W70-06722

GREENWOOD V EVERGREEN MINES CO (OBSTRUCTION OF NATURAL FLOW BY MUNICIPALITY).

19 NW2d 726-735 (Minn 1945).

Descriptors: *Minnesota, *Artificial watercourses, *Flood damage, *Obstruction to flow, Lakes, Water levels, High water mark, Riparian land, Natural flow, Damages, Judicial decisions, Cities, Diversion, Alteration of flow, Legislation, Culverts, Surface waters, Riparian rights, Natural flow doctrine, Drains, Outlets, Legal aspects, Floods, Barriers, Administrative agencies.

The principal defendant, a municipality, had closed the naturaloutlet of a lake and installed culverts to carry away excess lake water. Over the years, the culverts became obstructed and during times of heavy rainfall the plaintiff's lakefront property was flooded, causing damage. The court held that plaintiffs were entitled to have the lake level remain at its natural high water mark, and that a municipality would be liable just as would a private defendant for obstructing the natural flow. While the defendant had statutory authority to close the natural outlet, it was under a duty to do so in a manner which would not damage lake front property. Defendant claimed, and the trial court found that as the state highway department had taken over the road under which most of the culverts ran, the defendant municipality had not breached any affirmative duty and that the highway department was negligent. However, the court held tha t the defendant had the means to clear the obstruction and in fact had eventually clared it. The municipality was thus held to be actively negligent, and the trial court decision was reversed. (Caldwell-Florida)
W70-06730

SWEIGART V BURKHOLDER (RIGHT TO DIVERT SURFACE WATERS ONTO ADJOINING LAND).
154 Pa Super 505, 36 A 2d 181-183 (1944).

Descriptors: *Pennsylvania, *Surface waters, *Natural flow, *Diversion, Ditches, Judicial decisions, Relative rights, Legal aspects, Barriers, Embankments, Retaining walls, Damages, Surface drainage, Surface runoff, Repulsion (Legal aspects), Riddance (Legal aspects), Natural flow doctrine, Natural streams.
Identifiers: *Dominant estate.

Plaintiff brought suit to enjoin defendants from diverting natural surface water over plaintiff's land by the erection of artificial barriers and embankments. Before the erection of the barriers, the natural flow of water over plaintiff's land was carried by a ditch separating defendants' and plaintiff's land. Defendants contended that the erection of the barriers was necessary to protect their property since plaintiff had first erected barriers on his land which unlawfully directed surface water onto defendants' land. The trial court found that the water running over defendants' land was limited to the natural flow of surface water and defendants were not entitled to divert its natural flow over the dominant estate of plaintiff. The court of appeals affirmed the judgement, stating that the owner of a dominant estate has an easement in a servient estate for the discharge of all waters which by nature rise in, flow or fall upon the dominant estate. (Huebner-Florida)
W70-06731

4B. Groundwater Management

GROUND-WATER CONDITIONS DURING 1968, VANDENBERG AIR FORCE BASE AREA, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
J. H. Koehler.
Geological Survey Open-file Report, February 6, 1970. 20 p, 7 fig, 3 tab, 4 ref.

Descriptors: *Water levels, *Groundwater, *Water supply, *California, Water utilization, Water wells, Withdrawal, Aquifers, Water quality, Drawdown, Manganese, Water yield, Water storage.
Identifiers: Vandenberg Air Force Base (Calif).

The water supply for Vandenberg Air Force Base is obtained from supply wells in Lompoc terrace, Lompoc plain, and San Antonio Valley. About 5,790 acre-feet of water was pumped during calendar year 1968. Between November 1967 and November 1968 the average water-level decline in Lompoc terrace was 0.2 foot; in Lompoc plain, about 1.8 feet; and in the San Antonio Valley area, about 0.5 foot. The water level in the supply wells in San Antonio Valley did not decline in 1968. The decline in water levels indicates a decrease in groundwater in storage. Because of the high dissolved-solids content in the water in the Lompoc plain and Lompoc terrace areas, new domestic supply wells, when needed, should be drilled in the San Antonio Valley area. The fluoride concentration in the base supply wells is less than the lower limit recommended by the U.S. Public Health Service. A trace element analysis indicates a manganese concentration of about four times the recommended upper limit. (Knapp-USGS)
W70-06321

GEOLOGY AND GROUNDWATER RESOURCES OF GRAND FORKS COUNTY, NORTH DAKOTA, PART 3-GROUNDWATER RESOURCES,
Geological Survey, Bismarck, N. Dak.
For primary bibliographic entry see Field 02F.
W70-06337

GEOLOGY FOR PLANNING IN DE KALB COUNTY, ILLINOIS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 02F.
W70-06338

AVAILABILITY OF WATER FOR ARTIFICIAL RECHARGE, PLAINS GROUNDWATER MANAGEMENT DISTRICT, COLORADO,
Geological Survey, Denver, Col.
C. T. Jenkins, and W. E. Hofstra.
Colorado Water Conservation Board Groundwater Series Circular No 13, 1970. 16 p, 6 fig, 3 tab, 5 ref.

Descriptors: *Water sources, *Surface waters, *Artificial recharge, *Colorado, Aquifers, Alluvium, Streamflow, Reservoir design, Precipitation (Atmospheric), Runoff, Evapotranspiration.
Identifiers: Ogallala Formation.

The Plains Groundwater Management District (Colorado) and the U.S. Geological Survey began a cooperative study in March 1969 to investigate the availability and distribution of surface water for artificial recharge to the Ogallala aquifer. The mean annual surface runoff out of the Plains District is estimated to be about 12,000 acre-ft per year, compared to groundwater withdrawals of about 142,000 acre-ft (1968). The surface runoff amounts to about 0.13 inch per year of a total of 16 inches of precipitation. If impounding structures were located in or upgradient from the groundwater withdrawal area, the amount of water available would be less than that available at the boundaries of the District. Extensive recharge operations therefore may not be feasible. Water in some of the stream channels contributes substantial recharge to the aquifer under present conditions. Runoff from about 20% of the area of the District is caught in playas and does not contribute to surface runoff out of the District. Some of this water recharges the aquifer but most of it is lost by evaporation. A significant amount of water probably could be salvaged by pumping water from playas or tailwater ponds into irrigation systems. (Knapp-USGS)
W70-06339

GEOLOGY AND GROUNDWATER RESOURCES OF WELLS COUNTY, NORTH DAKOTA: PART III - GROUNDWATER RESOURCES,
Geological Survey, Bismarck, N. Dak.
For primary bibliographic entry see Field 02F.
W70-06340

GEOLOGY AND RELATED GROUNDWATER OCCURRENCE, SOUTHEASTERN MASON COUNTY, WASHINGTON,
Department of Water Resources, Olympia, Washington.
For primary bibliographic entry see Field 02F.
W70-06341

THE YORK COUNTY GROUNDWATER WITHDRAWAL INVESTIGATION, 1968,
Nebraska Univ., Lincoln. Dept. of Agricultural Engineering.
Deon Axthelm, and Ismet Bozkurt.
Nebraska Univ Agricultural Engineering Report No. 1, August 1969. 6 p, 1 tab, 3 append.

Descriptors: *Water levels, *Groundwater, *Withdrawal, *Irrigation water, *Nebraska, Surveys, Water level fluctuations, Data collections, Hydrologic data, Water utilization, Recharge, Precipitation (Atmospheric), Water balance.
Identifiers: *York County (Nebr).

Irrigation withdrawals of groundwater were determined in York County, Nebraska, in 1968. There were 149 registered wells in York County in 1949. The number increased to about 1,580 in the fall of 1968--almost 10 times more wells in 20 years. On the average, 70 wells were added per year. However, during the dry period of 1955 to 1957, there was a great increase in the annual number of wells installed; over 300 in 1956. Although the increment has begun to decrease in recent years, it is expected that the construction of new and larger capacity wells will continue. The average of the values calculated by operator records and by power consumption shows 97,686 acre-feet of water withdrawal for 1968. The climatological data from the U.S. Weather Bureau Stations at Gresham, Bradshaw, McCool Junction, Utica, and York show an average of 28.11 inches of precipitation for the year 1967 compared to 38.88 inches which fell in 1968 or a ratio of 1.4 times more. The irrigation season for both years was primarily in July and August. The records show that there was about twice as much rainfall in 1968 during the irrigation season than in 1967. In contrast to previous records the groundwater levels increased on the average about +0.22 feet from June 1968 to June 1969. Although there was a net positive change, water table levels in some areas were lower and in some locations they were considerably higher. (Knapp-USGS)
W70-06360

WATER WELLS AND SPRINGS IN PANAMINT, SEARLES, AND KNOB VALLEYS, SAN BERNADINO AND INYO COUNTIES, CALIFORNIA,
Geological Survey, Menlo Park, Calif.
W. R. Moyle, Jr.
Copies of report available for sale from State of California, Office of Procurement, Documents Section, P. O. Box 20191, Sacramento, Calif 95820 - Price $2.00. California Department of Water Resources Bulletin No 91-17, December 1969. 110 p, 5 tab, 33 map, 12 ref.

Descriptors: *Water wells, *Springs, *California, Groundwater, Water yield, Water utilization, Water levels, Water level fluctuations, Drawdown, Specific capacity, Geology, Hydrogeology, Hydrologic data, Data collections.
Identifiers: Panamint Valley (Calif), Searles Valley (Calif), Knob Valley (Calif).

Water wells and springs in Panamint, Searles, and Knob Valleys, California were surveyed as part of a series on water wells and springs in southern California desert areas. The series is prepared by the U.S. Geological Survey and published by the California Department of Water Resources. Each bulletin locates water wells and springs in a part of the southern California desert region; describes well depth and yield, water use and level on dates observed; names the well owner; provides pumping data, including depths, rates, static water levels, drawdowns, and specific capacities; and includes lithologic data from drillers' well logs. (Knapp-USGS)
W70-06363

ROTHRAUFF V SINKING SPRING WATER CO (BENEFICIAL USE OF GROUNDWATER AND ADJOINING LANDOWNER'S RIGHTS).

14 A2d 87-92 (Penn 1940).

Descriptors: *Pennsylvania, *Supply contracts, *Water contracts, *Water supply, Water shortage, Water demand, Water requirements, Legal aspects, Groundwater, Groundwater mining, Springs, Interbasin transfer, Adjudication procedure, Judicial decisions, Natural flow doctrine, Relative rights, Water rights, Usufructuary right.

Defendant water company contracted with plaintiffs to purchase, for sale to the public, the effluent from a spring on plaintiff's land. In oreder to augment its water supply, defendant contracted with plaintiff at the same price to sink a well on the same tract. The well increased the total water supply but decreased the output of the spring. Requiring a still larger supply, defendant purchased land adjoining plaintiffs' and drilled another well thereon which produced water but caused plaintiff's spring to dry up. The well on plaintiff's property continued to pump, however, and plaintiffs were paid according to the contract. Plaintiffs sought damages for breach of the first spring contract on the theory that the prevention by a party to a contract of performance by the other party constitutes a breach of the contract. The court held that when a spring which depends on percolations through the land of an adjoining owner is destroyed through use for a 'lawful purpose', absent malice or negligence, such owner is not liable for damages caused thereby. The court found the better American view to be that the phrase 'lawful purpose' contemplated a use limited to the beneficial enjoyment of the land, and that a diversion or sale to others, which impaired the supply of water on the property of another, was not a use for a 'lawful purpose.' In drilling the second well, defendant prevented plaintiffs from performing the contract and were liable for the breach thereof. The measure of damages, however, was limited to the contract price, multiplied by the reduced output of the spring after the first well was drilled, for the life of the contract. (Clarke-Florida)
W70-06397

GROUNDWATER SUPPLY OF CAPE HATTERAS NATIONAL SEASHORE RECREATIONAL AREA, NORTH CAROLINA - PART 6,
Geological Survey, Raleigh, N.C.
Orville B. Lloyd, Jr. and Roberta B. Dean.
North Carolina Department of Water Resources Report of Investigations No 7, 1968.

Descriptors: *Water supply, *Camp sites, *National seashores, *North Carolina, *Groundwater, Water wells, Aquifers, Saline water intrusion, Safe yield, Sands, Silts, Saline water, Infiltration, Recharge.
Identifiers: Cape Hatteras National Seashore.

Pea Island Campground, part of Cape Hatteras National Seashore Recreational Area, is at the northern end of Hatteras Island. A groundwater investigation at the campground site was made to determine the thickness, extent, and lithic character of the water-bearing formations and the movement, quantity, and chemical quality of the groundwater. Three sand aquifers separated by silt underlie the Pea Island Campground area to depths of about 60 feet. The medium-grained sand unit between approximately 9 and 24 ft below mean sea level is the most desirable water-bearing zone for developing future groundwater supplies, because it contains the largest amount of water of good quality in the area. Upward leakage of saline groundwater occurs after more than a 0.5 ft head differential is established. (Knapp-USGS)
W70-06399

MILLERS RIVER BASIN, MASSACHUSETTS BASIC-DATA REPORT NO.11-GROUNDWATER SERIES,
Geological Survey, Boston, Mass.
Donald R. Wiesnet, and William B. Fleck.
Geological Survey Open-file Report, 1967. 29 p, 1 fig, 1 plate, 9 tab.

Descriptors: *Groundwater, *Water wells, *Data collections, *Hydrologic data, *Massachusetts, Water wells, Aquifers, Water yield, Water quality, Water levels, Hydrographs, Maps.
Identifiers: Millers River basin (Mass).

This report presents, in tabulated form, much of the groundwater basic data collected in the Massachusetts portion of the Millers River basin during a comprehensive study of water resources. Tabulated data include geologic units, well records, well logs, test-hole logs, chemical analyses, watersupply system data, and a list of water reports available for Maine, Massachusetts, and New Hampshire. Hydrographs show monthly water levels in observation wells. (Knapp-USGS)
W70-06405

SHICK V DEARMORE (RIGHTS TO WATER WELL).

442 SW2d 198-201 (Ark 1969).

Descriptors: *Arkansas, *Well casings, *Water wells, *Contracts, Judicial decisions, Legal aspects, Water sources, Water supply, Drilling, Steel pipes, Well spacing, Drilling equipment, Potable water, Negotiations, Third party effects, Boundaries (Property), Consumptive use, Relative rights.

Plaintiff property owner brought suit to enjoin defendant well-driller from removing a water well or from claiming a well-driller's lien on a well mistakenly drilled on plaintiff's property. Defendant counter-claimed for the contract price of the well. The trial court held for plaintiff and defendant appealed. Plaintiff had sold land to a third party who contracted with defendant to drill a water well. The third party abandoned the land and the contract with defendant. The well was mistakenly drilled on plaintiff's land. The lower court ruled for plaintiff adhering to the common-law rule that a permanent improvement that was placed upon another's land by mistake becomes part of the realty. The question on appeal was whether defendant was entitled to remove the casing that he installed on plaintiff's land. The appellate court exercised its equitable jurisdiction and deviated from the common-law rule. The court found that to refuse to allow the removal of the casing would be to unjustly enrich the plaintiff to the extent of the value of the well. The case was reversed and remanded. (Barnett-Florida)
W70-06486

CITY OF ATLANTA V HUDGINS (ACTION BY PROPERTY OWNER AGAINST THE MUNICIPALITY FOR UNLAWFUL DIVERSION OF WATERS).
19 SE2d 508-516 (Ga 1942).

Descriptors: *Georgia, *Water wells, *Water rights, *Beneficial use, Lakes, Cities, Reasonable use, Alteration of flow, Groundwater, Judicial decisions, Legal aspects, Non-navigable waters, Remedies, Riparian rights, Natural flow doctrine, Relative rights, Right-of-way, Sewers, Disposal, Subsurface drainage, Eminent domain, Damages, Diversion, Water pollution.

Plaintiff owned a tract of land on which was situated water wells and a lake fed by a stream emanating from nearby springs. Defendant condemned a right-of-way across the land for the purpose of constructing a trunk sewer to service the metropolitan area. Plaintiff alleged that defendant, in constructing the sewer negligently destroyed property and diverted water normally flowing to plaintiff's lands, depriving her of the reasonable use and benefit thereof. The court stated that the owner of the land through which non-navigable water flows is entitled to an action for damages if the water is obstructed, polluted, or diverted or if the landowner is deprived of the beneficial use thereof. In this case, however, plaintiff failed to allege that such diversion was caused by defendant's construction and consequently failed to state a cause of action. (Barnett-Florida)
W70-06490

WATER SUPPLY WELL SRC-2, STALLION RANGE CENTER, WHITE SANDS MISSILE RANGE, SOCORRO COUNTY, NEW MEXICO,
Geological Survey, Albuquerque, N. Mex.
Forest P. Lyford.
Geological Survey Open-file report, February 1970. 26 p, 8 fig, 3 tab, 3 ref.

Descriptors: *Water supply, *Saline water, *Water wells, *New Mexico, *Desalination, Hydrogeology, Hydrologic data, Aquifers, Data collections, Water quality, Geology.
Identifiers: White Sands Missile Range (N Mex).

White Sands Missile Range water-supply well SRC-2 was drilled to augment the volume of nonpotable water available from existing well SRC-1 so that sufficient water would be available to supply a desalting plant with an input of 200,000 gpd. Well SRC-2 was completed at a depth of 700 feet, 575 feet northwest of well SRC-1. Aquifer tests made in well SRC-2 indicated that the aquifer has a transmissivity of 140 sq ft/day. Measurements made in well SRC-1 indicate a storage coefficient for the aquifer of about 0.00029. A permanent pumping rate of 160 gpm, which would yield about 230,000 gpd, is recommended for well SCR-2. Well SRC-1 is also capable of yielding similar quantities; thus, the yield of either well would supply the maximum input needed for the desalting plant. The water contains about 2,100 mg/liter of sulfate and has a dissolved-solids content of about 3,100 mg/liter. (Knapp-USGS)
W70-06513

HYDROLOGIC SITUATION NORTH OF SNIPES MOUNTAIN NEAR SUNNYSIDE, YAKIMA COUNTY, WASHINGTON,
Geological Survey, Tacoma, Wash.
H. H. Tanaka, and A. J. Hansen, Jr.
Geological Survey Open-file report, February 1970. 12 p, 5 fig, 4 ref.

Descriptors: *Water wells, *Water levels, *Aquifers, *Washington, Water yield, Drawdown, Basalts, Alluvium, Water supply, Irrigation water.
Identifiers: Well interference, Sunnyside (Wash).

The hydrologic situation north of Snipes Mountain near Sunnyside, Yakima County, Washington was studied relative to drilling of a well to produce 1,800 gpm, and the effects of such withdrawal on the yield of two nearby domestic wells. A well 400 feet deep at the proposed site probably will tap the same aquifer as the present wells, and consequently there will be interference. However, recharge caused by additional irrigation from the proposed well will lessen the interference. A rough estimate is that the pumping at the proposed well would

cause a reduction in hydraulic head amounting to several tens of feet under these conditions. (Knapp-USGS)
W70-06518

GEOHYDROLOGY OF THE CROSS-FLORIDA BARGE CANAL AREA WITH SPECIAL REFERENCE TO THE OCALA VICINITY,
Geological Survey, Tallahassee, Fla.
For primary bibliographic entry see Field 04A.
W70-06534

EFFECTIVE USE AND CONSERVATION OF GROUNDWATER,
P. C. Lindenbergh.
In: Freshwater, Council of Europe, Nature and Environment Series, No 2, p 71-106, 1968. 36 p, 3 fig, 3 plate, 26 ref.

Descriptors: *Water resources development, *Groundwater, Water supply, Safe yield, Water yield, Artificial recharge, Groundwater basins, Social aspects, Legal aspects, Urbanization, Planning, Water management (Applied).
Identifiers: Water resources research.

Groundwater is one portion of the earth's hydrologic cycle. It is important to investigate development of groundwater for water supply in the most economical way. It is to be expected that the demand for groundwater will continue to increase. At present, overdraft already occurs in many groundwater basins. Until overdrafts are reduced to safe yields in groundwater basins, permanent damage or depletion of groundwater supplies must be anticipated (restrict demand). Artificial recharge is useful for reducing or terminating overdraft and may be defined as augmenting the natural replenishment of groundwater storage and, where necessary, preventing salt-water intrusion. National and international groundwater research programs are necessary to anticipate future problems and propose technical and economical solutions before groundwater projects are designed and planned. (Knapp-USGS)
W70-06570

HARTFORD RAYON CORP V CROMWELL WATER CO (DIMINUTION OF BROOK FLOW CAUSED BY WELL SINKING).

10 A2d 587-589 (Conn 1940).

Descriptors: *Connecticut, *Percolating waters, *Drawdown, *Riparian rights, Alteration of flow, Competing uses, Diversion, Judicial decisions, Legal aspects, Municipal waters, Natural use, Obstruction to flow, Prescriptive rights, Riparian land, Riparian waters, Watersheds (Divides), Water sources, Streams, Remedies, Industries, Industrial water, Water supply, Relative rights, Wells.

The plaintiff operated a manufacturing plant upon a tract of land through which flowed a brook. A dam was maintained upon plaintiff's premises and the water of the brook was adapted for processing plaintiff's products. The defendant water company bought land bordering upon the brook and within the watershed. The land was located about a mile above the plaintiff's factory. Defendant proposed to sink a well upon this land in order to provide water for the city it served. Plaintiff's action for a permanent injunction against construction of the well resulted in an adverse judgment. The Connecticut Supreme Court affirmed for defendant and held that an injunction based on the ground that the well would capture the percolating water flowing into the brook did not lie to restrain the water company from drilling the well. The court held that until it was proven that the sinking of the well would actually divert water, it could not be shown that the plaintiff had suffered any legal injury. The court reasoned that the rights of the plaintiff, claimed as a riparian proprietor and through prescription because of the use of the dam, were not to control the defendant's use of the water passing into the brook. (Powell-Florida)
W70-06660

BOROUGH OF WALLINGTON V TUBE REDUCING CORP (INDUSTRIAL WELLS IN VIOLATION OF LOCAL ORDINANCE).
42 A2d 757-758 (N J 1945).

Descriptors: *New Jersey, *Water wells, *Reasonable use, *Industries, Groundwater, Withdrawal, Wells, Injection wells, Local governments, Remedies, Zoning, Cities, Land use, Water utilization, Legal aspects, Judicial decisions, Public health, Water sources, Water supply, Pumping, Recharge.

Plaintiff municipality sought to prevent defendant corporation from withdrawing water through wells in violation of local zoning ordinance. The court held that injunction would not lie, as the bulk of the water withdrawn was discharged again through injection wells, and no irreparable harm could be shown by the plaintiff. Neither was detrimental effect on the public health and welfare shown. The court stated that the owner of land was entitled to the reasonable use of the groundwater under his property and expressed doubt as to the constitutionality of an ordinance restricting that use. As no equitable jurisdiction was shown, the bill was dismissed. (Caldwell-Florida)
W70-06676

A STUDY OF THE HYDROLOGY AND GEOLOGY OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
For primary bibliographic entry see Field 02F.
W70-06705

A STUDY OF DATA PREPARATION FOR MATHEMATICAL MODELING OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
For primary bibliographic entry see Field 02F.
W70-06706

4C. Effects on Water of Man's Non-Water Activities

ENVIRONMENTAL AND TECHNICAL FACTORS FOR OPEN DRAINAGE CHANNELS IN MILWAUKEE,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 04A.
W70-06318

HYDROLOGY OF A SMALL RURAL WATERSHED UNDER SUBURBAN DEVELOPMENT - PHASE I,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
For primary bibliographic entry see Field 02A.
W70-06447

THE EVERGLADES: A THREATENED ECOLOGY,
Miami Univ., Fla. Inst. of Marine Science.
For primary bibliographic entry see Field 06G.
W70-06539

AVAILABILITY OF RAINFALL-RUNOFF DATA FOR PARTLY SEWERED URBAN DRAINAGE CATCHMENTS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 02A.
W70-06573

FRANKLIN COUNTY COMPREHENSIVE PLAN.
Franklin County Planning Commission, Columbus, Ohio.
For primary bibliographic entry see Field 06B.
W70-06710

4D. Watershed Protection

SEDIMENTATION IN PLUM CREEK SUB-WATERSHED NO. 4, SHELBY COUNTY, NORTH-CENTRAL KENTUCKY,
Geological Survey, Washington, D.C.
For primary bibliographic entry see Field 02J.
W70-06334

COMPILATION OF HYDROLOGIC DATA, ELM FORK TRINITY RIVER, TRINITY RIVER BASIN, TEXAS - 1967.
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02E.
W70-06350

RIGHTS OF DRAINAGE; PRIVATE DRAINS (ROAD GRADES NOT TO OBSTRUCT NATURAL DRAINAGE).

Wis Stat Ann secs 88.87-88.94 (Supp 1969).

Descriptors: *Wisconsin, *Drainage, *Obstruction to flow, *Drainage systems, Legislation, Legal aspects, Surface drainage, Ditches, Drainage practices, Drainage programs, Drainage water, Land management, Highways, Roadbanks, Road construction, Embankments, Surface waters, Watercourses (Legal), Flood control, Water management (Applied), Railroads, Industrial water, Engineering structures, Cities, Local governments, Streamflow, Damages, Flood control, Controlled drainage.

Whenever any county, town, city, village, railroad company, or the State Highway Commission constructs or maintains any highway or railroad grade in or across any marsh, lowland, natural depression, natural watercourse, natural or man-made channel or drainage course, it must not unreasonably obstruct the natural drainage of surface or stream water. The public authority of railroad company may purchase drainage rights and easements in order to prevent damage to property owners. Ever owner or user of land who obstructs the flow of stream water has a duty to protect a downstream or upstream highway or railroad grade from water or flooding caused by such obstruction. The downstream highway or railroad grade is protected by directing the flow of surface waters into existing highway or railroad drainage systems. The upstream grade is protected by permitting drainage away from the grade essentially as if the obstruction had not been created. A railroad company must construct a ditch or sluiceway across its right-of-way where such structure would properly drain the petitioning owner's land. Whenever any embankment, grade, culvert or bridge across a natural watercourse obstructs such watercourse and diverts water upon any lands of a drainage district, the waterway flowing through such structure must be enlarged. The procedures for removal or obstructions from natural watercourses by a damaged landowner or occupant are provided. Procedures for the installation of drains by an agricultural landowner are set forth. (Powell-Florida)
W70-06361

DAVIS V COBB COUNTY (STOPPAGE OF SPRING).
7 SE2d 324-325 (Ct App Ga 1940).

Descriptors: *Georgia, *Springs, *Obstruction to flow, *Riparian rights, Natural flow doctrine, Reasonable use, Damages, Land tenure, Non-navigable waters, Streams, Judicial decisions, Legal aspects, Right-of-way, State governments, Local

governments, Administrative agencies, Ownership of beds, Remedies, Real property, Condemnation, Streamflow.

Plaintiffs alleged that defendant, while grading a road right-of-way, dumped excess dirt into a spring, which resulted in stopping it up and shutting off the stream which naturally flowed through plaintiffs' property. The court said that the owner of land through which a non-navigable stream flowed was entitled to have the water in the stream come to his land in its natural and usual flow, subject only to such dimunition as may be caused by reasonable use of the water by upstream riparian owners. Holding that the right of a riparian owner to the flow of the water was equal to his right to possession of the beds underneath the water, the court reversed a decision below for the defendant. This right was private property, said the court, and could not be taken without compensation, regardless of whether the property had actually been taken for public use. (Caldwell-Florida)
W70-06368

IMPORTANCE OF NATURAL VEGETATION FOR THE PROTECTION OF THE BANKS OF STREAMS, RIVERS AND CANALS,
For primary bibliographic entry see Field 03B.
W70-06401

RESEARCH ON SLEEPERS RIVER AT DANVILLE, VERMONT,
Agricultural Research Service, Plainfield, Vt.
Martin L. Johnson.
ASCE Proceedings, Journal of the Irrigation and Drainage Division, Vol 96, No IR1, Paper 7184, p 67-88, March 1970. 22 p, 8 fig, 7 tab, 13 ref, 3 append.

Descriptors: *Stream gages, *Small watersheds, *Rainfall-runoff relationships, *Snowmelt, *Surface-groundwater relationships, Water yield, Instrumentation, Runoff, Open channel flow, Climatology, Meteorology, Evapotranspiration, Hydrologic cycle, Water balance, Hydrologic budget, Water quality.
Identifiers: Sleepers River (Vermont).

Research in hydrology and biology at Danville, Vermont is focused upon the complex physical processes in natural watersheds, leading to development of methods for predicting behavior of ungaged areas. Reliability of a precipitation gage record for specifying daily amounts at other points of interest was investigated by establishing correlation response surface around gages. Measurement of runoff production to streams suggests most of the contribution to storm hydrographs is produced in the immediate vicinity of channels. Diurnal fluctuations in streamflow may be accounted for by evaporation from streams and adjacent wet areas. Many coliform bacteria from storm samples are of streambed and bank origin, not from overland flushing of pollutants into streams. Cation concentrations in streams increase downstream, and are highly correlative with discharge. Distribution of aquatic insects in five streams was a function of water temperature and channel velocity only. (Knapp-USGS)
W70-06519

ECOLOGICAL CONSEQUENCES OF THE MANAGEMENT OF CATCHMENT AREAS AND INFLUENCE OF FORESTS ON RIVER BASINS,
Z. Salverda.
In: Freshwater, Council of Europe, Nature and Environment Series, No 2, p 11-31, 1968. 21 p, 1 fig, 5 plate, 76 ref.

Descriptors: *Watershed management, *Forest management, Water yield improvement, Flood control, Ecology, Vegetation effects, Planning, Economics, Conservation, Water resources development, Social aspects, Legal aspects, Environmental engineering.
Identifiers: River basin management.

Watershed management frequently has far-reaching ecological consequences, especially in recovering watershed areas which suffered devastation after hundreds of years of neglect and mismanagement. Afforestation is not always the method best suited to a region; numerous other measures may be preferable. Regard must be paid to social and economic interests which are often conflicting. Watershed planners have to participate in general (preferably long-term) development programs. Unsolved water supply problems have a far-reaching effect on the economy, inasmuch as the measures involved in restoring and managing watersheds may affect regions, whole countries or even adjacent countries. Conservation of natural resources also involves educational factors, which are essential to the achievement of the desired aim. A watershed program generally has two main objectives with opposing principles: control of excess water with the help of a maximum of vegetation cover; and optimum water yield by retaining a minimum vegetation cover. The principles of watershed management by means of forestry measures not only differ according to the aim in view but also highly dependent on climate, soil conditions and topography. (Knapp-USGS)
W70-06569

COMMUNITY ACTION GUIDEBOOK FOR SOIL EROSION AND SEDIMENT CONTROL,
National Association of Counties Research Foundation, Washington, D.C.
For primary bibliographic entry see Field 05G.
W70-06574

05. WATER QUALITY MANAGEMENT AND PROTECTION

5A. Identification of Pollutants

DETERMINATION OF DEGRADED DYES AND AUXILIARY CHEMICALS IN EFFLUENTS FROM TEXTILE DYEING PROCESSES,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
R. K. Flege.
Available from the Clearinghouse as PB-191 708, $3.00 in paper copy, $0.65 in microfiche. Environmental Resources Center, Georgia Institute of Technology, ERC-0270, March 1970. 42 p, 2 tab, 7 fig, 22 ref, append. OWRR Project B-027-GA (1).

Descriptors: *Textiles, *Dyehouse effluents, *Dye releases, *Dye degradation, *Carriers (Dye), Chemical wastes, Color, Waste treatment, Pollutants, Chemical oxygen demand, Activated sludge, Anaerobic digestion.

Selected dyes and auxiliary chemicals used in dyeing processes were tested in a laboratory environment simulating that to which dyehouse effluents would be subjected in a conventional activated sludge waste treatment process. Dyes and auxiliary chemicals studied were those most widely used today. Disperse dyes (anthraquinone) were only partially degraded in the laboratory tests. Because of the insolubility of the disperse dyes, the undegraded dyes and metabolites were separated from the degraded dyes before identification was attempted. Three fiber reactive dyes of the vinyl sulfone class studied were not appreciably degraded by the activated sludge waste treatment process. Color of the original dye persisted in the effluent and no metabolites could be identified. Dyes subjected to anaerobic digestion rapidly lost color. No indication was found that the dyes were toxic to the biota of either treatment process. Fourteen chemical auxiliaries (carriers) together with four commercial proprietory carriers were studied. Some carriers were readily degraded and some were toxic and/or inert. Commercial carriers were found more resistant to degradation than the reagent grade active chemicals used in their formulation. (Conway-Georgia Tech)
W70-06316

PRELIMINARY RESULTS FROM STATISTICAL ANALYSIS OF WATER QUALITY IN SELECTED STREAMS OF NEBRASKA,
Geological Survey, Lincoln, Nebr.
Kenneth A. MacKichan, and Neil G. Stuthmann.
Geological Survey Open-file Report, October 24, 1969. 35 p, 18 fig, 9 tab, 3 ref.

Descriptors: *Water quality, *Sampling, *Monitoring, *Nebraska, Statistical methods, Statistics, Chemical analysis, Water analysis, Correlation analysis, Regression analysis, Solutes, Electrical conductance.
Identifiers: Water quality sampling.

Chemical data for selected streams in Nebraska were analyzed statistically to determine if changes in the current sampling regimen would be desirable. Once accuracy limits are specified and estimates of the variability are obtained, the number of analyses required to define mean values for dissolved solids and individual constituents within those limits can be calculated by means of the regression function. Specific conductance, an inexpensive measurement, can be used as an independent variable to estimate the concentrations of dissolved solids and of dissociated ions such as calcium and sulfate. Other independent variables such as discharge, source of flow, and season may be used to improve the regression function. (Knapp-USGS)
W70-06349

NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS - WATER YEAR 1970.
Geological Survey, Washington, D.C. Water Resources Div.

Geological Survey National Reference List of Water Quality Stations, 1970. 701 p, 6 tab, index.

Descriptors: *Water quality, *Data collections, *Stations, Networks, Facilities, Sampling, Water analysis, Water chemistry, Monitoring, Sediment load, Water temperature.
Identifiers: Water quality stations.

The water-quality stations maintained by the U.S. Geological Survey for the collection of basic data on the chemical and physical characteristics of streams in the United States and its territories are listed. The stations are listed in alphabetical order by State, in downstream order by part (major drainage basins), and stations that discontinued operations at the end of the previous water year. Data listed for each station consists of identification number, latitude and longitude, station name, drainage area, State, county, date established, type of data collected (chemical sediment, temperature), available discharge records, frequency of sampling, type of project, source of operating funds, number of years the station has been in operation, and the constituents determined by analysis in the laboratory, in the field, or by digital monitor. This information is also summarized by State. The data collected from stations on this list may be obtained by writing the U.S. Geological Survey, Water Resources Division, Automatic Data Processing Unit, Washington, D.C. 29240. This list is prepared annually. (Knapp-USGS)
W70-06514

QUANTITATIVE METHODS FOR THE CONCENTRATION OF VIRUSES IN WASTE WATER,
Arizona Univ., Tucson. Dept. of Microbiology.
For primary bibliographic entry see Field 05D.
W70-06628

GROSS RADIOACTIVITY IN SURFACE WATERS OF THE UNITED STATES FEBRUARY 1969.
Federal Water Pollution Control Administration, Washington, D.C. Div. of Pollution Surveillance.

Radiological Health Data and Reports, Vol 10, No 9, p 394-395, 1969. 1 fig, 1 tab, 7 ref.

Descriptors: *Radioactivity, *Surface waters, *United States, Sampling, Montana, South Dakota, Tennessee, California, Arizona, Minnesota, Missouri, North Dakota, Nebraska, Colorado River, Great Lakes, Mississippi River, Missouri River, Ohio River.
Identifiers: Beta radioactivity, Alpha radioactivity, Big Horn River (Mont), Big Sioux River (S Dak), Clinch River (Tenn), Cumberland River (Tenn), Kansas River (Kans), Little Miami River (Ohio), North Platte River (Neb), Platte River (Neb), Rainy River (Minn), Red River (N Dak), South Platte River (Colo), Yellowstone River (Mont), Sampling stations.

Monitoring surface waters for radioactivity levels is part of the Water Pollution Surveillance System. Current preliminary results of alpha and beta radioanalyses are presented. Radioactivity associated with dissolved solids provides a rough indication of levels which would occur in treated water, since nearly all suspended matter is removed by treatment processes. Strontium-90 results are reported semiannually. The average total beta radioactivity in suspended-plus-dissolved solids in raw water collected at nationwide stations is given. Special note is taken when alpha radioactivity reaches 15 picocuries per liter or greater, or when beta radioactivity is at 150 picocuries per liter or greater. These arbitrary levels reflect no public health significance, as the Public Health Service drinking water standards have already provided the basis for this assessment. Changes from or toward these arbitrary levels are also noted in terms of changes in radioactivity per unit weight of solids. Comments are made on monthly average values or when values are significantly high. North Platte and South Platte Rivers showed alpha radioactivity values above 15 picocuries/liter for either suspended or dissolved solids in February 1969. No stations showed beta radioactivity value above 150 picocuries/liter in February 1969. (Jones-Wisconsin)
W70-06656

MEASUREMENT OF POLLUTANT TOXICITY TO FISH I. BIOASSAY METHODS FOR ACUTE TOXICITY,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
J. B. Sprague.
Water Research, Vol 3, p 793-821, 1969. 6 fig, 1 tab, 125 ref.

Descriptors: *Reviews, *Bioassay, *Toxicity, *Measurement, *Test procedures, Aquatic animals, *Methodology, Control systems.
Identifiers: *Median tolerance limits, Estimating error, Acute toxicity, Chronic toxicity, *Toxicity curves, Toxicity threshold.

The review describes profitable methods for measuring lethal levels of pollutants for aquatic organisms. Methods for research in the laboratory are emphasized by the same principles could be applied in field work. Greater use of standard toxicological methods and terminology is urged. For 211 out of 375 toxicity tests reviewed, acute lethal action apparently ceased within 4 days, although this tabulation may have been biased towards short times by a large number of static tests. The incipient LC50 (lethal concentration for 50 per cent of individuals on long exposure) is recommended as the most useful single criterion of toxicity. If this cannot be estimated, the 4-day LC50 is a useful substitute, and often its equivalent. A desirable first step in toxicity tests is to estimate median lethal time for each of a series of concentrations on logarithmic paper. The curve helps to reveal any unusual features of toxicity. Whenever possible, tests should be prolonged until the toxicity curve becomes parallel to the time axis, indicating a lethal threshold concentration. The incipient LC50 is then estimated by selecting an exposure time from the asymptotic part of the toxicity curve; for this exposure time, observed mortality is plotted against concentration on log-probit paper, and the LC50 is read from an eye-fitted line. (Sjolseth and Katz-Washington)
W70-06692

5B. Sources of Pollution

REVIEW OF THE SANTA BARBARA CHANNEL OIL POLLUTION INCIDENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
W. H. Swift, C. J. Touhill, W. A. Haney, R. E. Nakatani, and P. L. Peterson.
Available from the Clearinghouse as PB-191 712, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series 15080 EAG, July 1969. 156 p, 51 fig, 7 tab, 29 ref. FWPCA Project 15080 EAG---7/69, Contract 14-12-530.

Descriptors: *Oily water, *California, *Environmental effects, Oil wastes, Water pollution sources, Water pollution effects, Water pollution control, Water pollution treatment, Oil wells, Offshore platforms, Toxicity.
Identifiers: *Santa Barbara Oil Spill.

On January 28, 1969, during operations to shut in well A-21 on the offshore drilling Platform A, about 6 miles southeast of Santa Barbara in 190 feet of water, a leak of mixed crude oil and gas occurred. For the first few days the crude oil largely remained in the Santa Barbara Channel. However, starting on February 4, southeasterly winds began to drive the oil ashore, resulting in contamination of beaches, harbors and coastline, and initiating perhaps the largest oil pollution clean-up operation in the United States. Ocean floor seepage associated with the well blowout was highly variable with respect to location and magnitude with time. Attempts to control the oil on the surface near the platform were largely unsuccessful. To encompass the entire area of oil emission, booms several thousand feet in length would have been required. Chemical dispersants are questionable. Recovery of the majority of the accumulated oil was accomplished by vacuum tank trucks and manual spreading of straw. The only method effective for removal of oil stains from rocks and jetties was high pressure water washing followed by sandblasting. Total known bird losses through March 31 in the area affected were determined to be 3600. Only minimal adverse effects on fish were noted. (Knapp-USGS)
W70-06320

RECONNAISSANCE OF WATER TEMPERATURE OF SELECTED STREAMS IN SOUTHEASTERN TEXAS,
Geological Survey, Austin, Tex.
For primary bibliographic entry see Field 02K.
W70-06343

CONSIDERATIONS ON A SEWER OUTFALL OFF NOBSKA POINT,
Woods Hole Oceanographic Institution, Mass.
Dean F. Bumpus, W. Redwood Wright, and Ralph F. Baccaro.
Available from the Clearinghouse as AD-700 895, for $3.00 in paper copy, $0.65 in microfiche. Technical rept., Woods Hole, Rept. No. WHOI-Ref-69-87, Dec. 69, 42 p. Contract DOT-CG-92841, Grant PHS-UI-0015899.

Descriptors: *Sewage disposal, *Water pollution sources, Phytoplankton, Ecology, *Water pollution effects, Beaches.
Identifiers: Nobska Point, Falmouth, Mass.

The effects of prospective secondary treatment domestic sewage effluent of about 14 thousand cu m per day on the marine environment of Martha's Vineyard and Nantucket Sounds has been examined. A steady state condition would be reached in 75 days when the sewage effluent would be diluted by a volume ranging from at least 1700 to 2800 parts of redwater for each part of effluent. The concentrations of nutrients added to the Sounds and the ecological effects would be less than is experienced in the normal annual cycle.
W70-06465

RELATIVE CONTRIBUTIONS OF NUTRIENTS TO THE POTOMAC RIVER BASIN FROM VARIOUS SOURCES,
Federal Water Pollution Control Administration, Annapolis, Md.; and New York State Dept. of Health, Albany. Div. of Environmental Health Service.
Norbert A. Jaworski, and Leo J. Hetling.
Chesapeake Technical Support Laboratory Technical Report No 31, Federal Water Pollution Control Administration, January 1970. 36 p, 13 fig, 6 tab, 8 ref.

Descriptors: *Nutrients, *Eutrophication, *Water pollution sources, *Estuaries, Rivers, Phosphates, Nitrates, Hudson River, Algae, Water quality, Sewage disposal, Waste water disposal, Sewage effluents, Farm wastes.
Identifiers: Potomac River Basin, Potomac estuary.

The upper Potomac estuary is highly eutrophic. During the summer months, large blooms of nuisance blue-green algae, mainly microcystis, occur in the fresh-water portion of the upper estuary. A relationship between high nutrient content and the accelerated eutrophication in the Potomac estuary has been established. The annual average concentration of phosphorus varied from 0.09 mg/liter in the South Branch to 1.9 mg/liter in the Antietam watershed. The annual average concentration of nitrogen varied from 0.3 mg/liter in the South Branch to 2.2 mg/liter in Opequon Creek. About 92,700 lbs/day of total phosphorus entered the Potomac in 1966, 87% from wastewater. The average 1966 loading of total nitrogen was about 125,000 lbs/day, 51% from wastewater. During low flow conditions a significant proportion of the phosphorus entering the surface water from the various sources in the upper basin is retained in the stream channel. At high stream flow, it appears that a large proportion of this phosphorus is 'flushed' out of the stream channel and transported downstream. A comparison of sources of nutrients in the Hudson River Basin to those in the Potomac supports the contention that in the Middle Atlantic Region the major source of nutrients to the aquatic ecosystem is from wastewater discharges. (Knapp-USGS)
W70-06509

TRITIUM CONCENTRATION IN PRECIPITATION, 1967-1968,
Southwestern Radiological Health Lab., Las Vegas, Nev.; and Southeastern Radiological Health Lab., Montgomery, Ala.
A. A. Moghissi, and C. R. Porter.
Radiological Health Data and Reports, Vol 11, No 3, p 137-140, March 1970. 4 p, 3 fig, 2 tab, 8 ref.

Descriptors: *Tritium, *Precipitation (Atmospheric), *Sampling, *Monitoring, Data collections, Fallout, Tracers, Hydrologic cycle, Radiochemical analysis, Networks.
Identifiers: Tritium sampling network.

Since the discovery of natural tritium, rain has been extensively monitored to study the production and behavior of this radionuclide in the hydrological cycle. It has been well established that under normal conditions--in the absence of the introduction of tritium by nuclear bomb testing--tritium concentration in rain will increase during spring and late summer in the Northern Hemisphere. In the Southern Hemisphere the conditions are similar, although less pronounced. Numerous studies have shown that tritium concentrations reach a maximum at latitude 45-60 deg N in the Northern Hemisphere. Beginning in 1967, the Bureau of Radiological Health established a tritium-in-rain network as part of the existing Radiation Alert Network. Ten stations were selected covering the United States, including Alaska and the Hawaiian Islands. The locations of these stations are shown. (Knapp-USGS)
W70-06515

ATMOSPHERIC EMISSIONS FROM WET-PHOSPHORIC ACID MANUFACTURE,
National Air Pollution Control Administration, Raleigh, N.C.; and American Cyanamid Co., Wayne, N.J.
George B. Crane, Donald R. Goodwin, and James H. Rook.
Copies avail for sale from Superintendent of Documents, US Government Printing Office, Wash, DC 20402--Price: $0.45. National Air Pollution Control Administration Publication No AP-57, April 1970. 86 p, 12 fig, 20 tab, 39 ref.

Descriptors: *Air pollution, *Phosphorus compounds, *Industrial plants, Chemical wastes, Water pollution sources, Phosphates, Fertilizers, Fluorides, Agricultural chemicals, Sampling, Analytical techniques, Pollution abatement.
Identifiers: *Atmospheric emissions, Phosphoric acid manufacture, Process description.

To provide reliable information on the nature and quantity of emissions from chemical manufacturing, the Manufacturing Chemists' Assoc., Inc., and US PHS, HEW, began a study in 1962 of emissions from selected processing plants and to publish data helpful to air pollution control and planning agencies and to chemical industry management. Background information is given on basic characteristics of the wet-process phosphoric acid industry, growth rate, uses for products, and number and location of producing sites. The process involves treatment of phosphate rock with sulfuric acid. Descriptions are given of commonly used process variations. Emission data represent about 20% of the operating plants. Range of emissions under normal operations and the performance of established methods and devices for controlling emissions are described. In 1966, about 3.5 tons of phosphoric acid (P205) was produced, mostly for various phosphate fertilizer products. Dust from phosphate rock grindings and fluoride compounds liberated by sulfuric acid are a potential source of air and water pollution. Total particulate emissions amount to about 0.20 lb per ton of acid for filter operation, and as much as 11 lb per ton for digester operation. Gypsum ponds contribute fluoride emissions depending on pH, temperature and wind speed--one pond studied showed a range of 0.4 to 1.8 lb of fluoride per acre per day, varying with temperature. (Lang-USGS)
W70-06521

SELECTION OF REFUSE DISPOSAL SITES IN NORTHEASTERN ILLINOIS,
Illinois State Geological Survey, Urbana.
George M. Hughes.
Illinois State Geological Survey Environmental Geology Note No 17, September 1967. 18 p, 2 fig, 1 tab, 41 ref.

Descriptors: *Waste disposal, *Garbage dumps, *Landfills, *Path of pollutants, *Hydrogeology, *Illinois, Municipal wastes, Leaching, Groundwater movement, Environmental sanitation, Environmental engineering, Water pollution sources.
Identifiers: Environmental geology.

Geologic environments in northeastern Illinois were evaluated in terms of results of studies on refuse disposal and groundwater contamination that have been made elsewhere. The geologic environments commonly considered as safe for refuse disposal in this area are those with materials of low permeability and those that are relatively dry. A third type of environment, one which is hydrologically protective, also should be considered for disposal purposes. (Knapp-USGS)
W70-06572

THERMAL POLLUTION AND THE WATER COOLING TOWER,
Marley Co., Kansas City, Mo.
For primary bibliographic entry see Field 05D.
W70-06640

EFFECT OF A STABILIZING GRADIENT OF SOLUTE ON THERMAL CONVECTION,
Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics.
George Veronis.
Journal of Fluid Mechanics, Vol 34, Part 2, 1968, p 315-336. 5 fig, 7 ref, 3 tab.

Descriptors: *Convection, Stratification, Diffusion.
Identifiers: *Prandtl number, *Rayleigh number, Thermal convection.

A stabilizing gradient of solute inhibits the onset of convection in a fluid which is subjected to an adverse temperature gradient. Furthermore, the onset of instability may occur as an oscillatory motion because of the stabilizing effect of the solute. These results are obtained from linear stability theory which is reviewed briefly in this paper before finite-amplitude results for two-dimensional flows are considered. A solute Rayleigh number, R sub s, is defined with the stabilizing solute gradient replacing the destabilizing temperature gradient in the thermal Rayleigh number. An effective diffusion coefficient, kappa sub rho, is defined as the ratio of the vertical density flux to the density gradient evaluated at the boundary and it is found that kappa sub rho = minus the square root of (kappa (kappa sub s)) where kappa, kappa sub s are the diffusion coefficients for temperature and solute respectively. (Guerrero-Vanderbilt)
W70-06641

THE UNSTABLE THERMAL INTERFACE,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 08B.
W70-06643

THE THERMOHALINE RAYLEIGH-JEFFREYS PROBLEM,
Auckland Univ. (New Zealand). Dept. of Mathematics.
D. A. Nield.
Journal of Fluid Mechanics, Vol 29, Part 3, 1967, p 545-558. 30 ref.

Descriptors: *Thermal stratification, *Numerical analysis, *Thermocline, Convection.
Identifiers: *Thermohaline, Thermal gradient.

The onset of convection induced by thermal and solute concentration gradients, in a horizontal layer of a viscous fluid, is studied by means of linear stability analysis. A Fourier series method is used to obtain the eigen value equation, which involves a thermal Rayleigh number R and an analogous solute Rayleigh number S, for a general set of boundary conditions. Numerical solutions are obtained for selected cases. Both oscillatory and monotonic instability are considered, but only the latter is treated in detail. The former can occur when a strongly stabilizing solvent gradient is opposed by a destabilizing thermal gradient. When the same boundary equations are required to be satisfied by the temperature and concentration perturbations, the monotonic stability boundary curve in the (R, S)-plane is a straight line. Otherwise this curve is concave towards the origin. For certain combinations of boundary conditions the critical value of R does not depend on S (for some range of S) or vice versa. This situation pertains when the critical horizontal wave-number is zero. A general discussion of the possibility and significance of convection at 'zero' wave-number (single convection cell) is presented in an appendix. (Guerrero-Vanderbilt)
W70-06644

THE INFLUENCE OF MOLECULAR DIFFUSIVITY ON TURBULENT ENTRAINMENT ACROSS A DENSITY INTERFACE,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
For primary bibliographic entry see Field 08B.
W70-06646

ON STRATIFIED FLOWS OVER BOTTOM TOPOGRAPHY,
Harvard Univ., Cambridge, Mass.
For primary bibliographic entry see Field 02E.
W70-06649

ACIDIC DISSOCIATION CONSTANTS OF SELECTED AQUATIC HERBICIDES,
Rutgers - The State Univ., New Brunswick, N.J. Dept. of Environmental Sciences.
Nancy Hunter Nelson, and Samuel D. Faust.
Environmental Science and Technology, Vol 3, No 11, p 1186-1188, 1969. 2 tab, 13 ref.

Descriptors: *2-4-D, *Herbicides, *Organic acids, Aquatic plants, Dalapon, 2-4-5-T, Potentiometers, Adsorption, Ion exchange, Coagulation.
Identifiers: Classical dissociation constant, 2-CPA, 4-CPA, MCPAN, MCPB, Fenac, Aquatic herbicides, Dissociation constants, Potentiometric titration.

Dissociation constants (pK) of organo-acidic aquatic herbicides at definite ionic strength (I) were established by potentiometric titration, as follows: for 2,4-D (2.73, I--0.05); 2,4,5-T (2.88, I--0.03); 2-CPA (2.92, I--0.05); 4-CPA (2.95, I--0.05); MCPA (3.05, I--0.03); MCPB (4.80, I--0.05); fenac (3.70, I--0.05); dalapon (1.84, I--0.05). A knowledge of dissociation constants is essential for calculation of the distribution of undissociated acid and anion species of herbicides under given pH and ionic strength. The availability of the molecule to enter oxidation-reduction reactions, dissolution, ionic exchange, coagulation, and adsorption is also influenced by dissociation constant of the eradicant. (Wilde-Wisconsin)
W70-06663

WATER QUALITY PROBLEMS PECULIAR TO ARID REGIONS,
New Mexico State Univ., University Park. Dept. of Soil Chemistry.
For primary bibliographic entry see Field 03B.
W70-06682

5C. Effects of Pollution

REVIEW OF THE SANTA BARBARA CHANNEL OIL POLLUTION INCIDENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05B.
W70-06320

GEOLOGIC INVESTIGATION OF THE SITE FOR AN ENVIRONMENTAL POLLUTION STUDY,
Illinois State Geological Survey, Urbana.
Paul B. DuMontelle.
Illinois State Geological Survey Environmental Geology Note No 31, March 1970. 19 p, 4 fig, 1 tab, 4 ref, append.

Descriptors: *Water pollution effects, *On-site investigations, *Soil investigations, *Geologic investigations, *Illinois, Hydrologic data, Geology, Hydrology, Hydrogeology, Infiltration, Permeability, Sampling, Groundwater movement, Path of pollutants, Environment.
Identifiers: Test holes, University of Illinois, Environmental pollution.

To study the effects of pollutants under simulated natural-flow conditions, the Illinois Natural History Survey is planning a study area containing 16 large ponds and 6 smaller ponds, interconnected by a central drain and a catchment basin. The larger ponds will measure 190 by 50 ft and the smaller ones 85 by 36 ft. They will be from 4 to 8 ft deep. The Champaign glacial moraine forms a prominent ridge trending northwest-southeast through the south part of Champaign and Urbana. The south side of the moraine has a very gentle slope of about 50 ft per mile, which exhibits the poorly defined

drainage system typical of topography related to glaciation. These uplands are undissected, but are a part of the Embarras River watershed to the south. The proposed site for the environmental pollution study is located in the mid-part of the south slope of the Champaign Moraine. The site chosen for the environmental pollution project is geologically feasible. The rectangular-shaped ponds may be satisfactorily constructed of in situ materials if some precautions are taken. (Knapp-USGS)
W70-06322

THE REDOX POTENTIALS IN SMALL OLIGO AND MEROMICTIC LAKES,
Oslo Univ. (Norway). Dept. of Limnology.
Johannes Kjensmo.
Nordic Hydrology, Vol 1, No 1, p 56-65, 1970. 10 p, 4 fig, 1 tab, 13 ref.

Descriptors: *Water chemistry, *Oxidation-reduction potential, *Meromixis, *Lakes, Water circulation, Water quality, Hydrogen sulfide, Oxidation.
Identifiers: Oligomixis.

The vertical distributions of redox potentials of the waters of three meromictic lakes and one oligomictic lake are described. The redox potentials of the waters from 0.5 m depth of the various lakes ranged from 0.491 to 0.565 volts. The bottom waters showed potentials in the range 0.030 to 0.069 volts. Lower potentials observed in 2 of the lakes may be due to the presence of reducing organic substances. The 2 lakes are typical coniferous forest lakes, and their catchment areas are relatively rich in Sphagnum bogs. The very small influence of the oxygen concentration on the oxygen potential is clearly demonstrated by the present investigation. In all 4 lakes the greatest fall in redox potential was recorded at depths well below the depths at which oxygen was analytically detectable. Characteristic for the lakes are high contents of iron in their deep waters. Considerable amounts of free hydrogen sulfide were present in the deep waters of the oligomictic lakes, a fact which was confirmed by a strong smell of hydrogen sulfide arising from this water. Hydrogen sulfide may have been the additional factor responsible for the lower potentials of this water as compared with the potentials of the deep waters of the three meromictic lakes. In the three meromictic lakes there was no smell of hydrogen sulfide from the deep waters. (Knapp-USGS)
W70-06327

EVALUATION OF THE EFFECT OF IMPOUNDMENT ON WATER QUALITY IN CHENEY RESERVOIR,
Colorado State Univ., Fort Collins.
J. C. Ward, and S. Karaki.
Supported by Bureau of Reclamation, Dept of Interior. Colorado State University Hydrology Paper No 38, March 1970. 69 p, 38 fig, 19 tab, 23 ref, append.

Descriptors: *Water quality, *Reservoirs, *Kansas, Thermal stratification, Dissolved oxygen, Water temperature, Sampling, Streamflow, Taste, Odor, Aquatic, Microorganisms, Water chemistry, Heat budget, Hydrologic budget, Salinity, Turbidity, Evaporation control, Reservoir design, Reservoir evaporation.
Identifiers: Cheney Reservoir (Kansas).

A study was conducted to determine the effect of impoundment on the quality of water in Cheney Reservoir. The reservoir did not stratify during the period of data collection. The increase in the dissolved solids concentration was shown to be directly related to evaporation. On an annual basis, 42 percent of the total inflow evaporated. Suggestions are presented for control of dissolved solids concentration. Evaporation control is suggested, but increase in reservoir temperature (12 to 19 deg F) may be undesirable. Bypassing some of the poorest quality waters of the stream serving Cheney Reservoir is suggested in order to reduce the dissolved solids concentration both in the reservoir and in the stream below the reservoir. The biological activity did not seem to affect the water quality materially. Odor stabilized at a threshold odor number of about 5. The dissolved oxygen saturation decreased somewhat from 100 percent at the water surface to roughly 82 percent at a depth of 25 feet. (Knapp-USGS)
W70-06336

A STUDY SUBMERGED DREDGE HOLES IN NEW JERSEY ESTUARIES WITH RESPECT TO THEIR FITNESS AS FINFISH HABITAT,
New Jersey Dept. of Conservation and Economic Development. Nacote Creek Research Station.
For primary bibliographic entry see Field 02L.
W70-06362

RELATIVE CONTRIBUTIONS OF NUTRIENTS TO THE POTOMAC RIVER BASIN FROM VARIOUS SOURCES,
Federal Water Pollution Control Administration, Annapolis, Md.; and New York State Dept. of Health, Albany. Div. of Environmental Health Service.
For primary bibliographic entry see Field 05B.
W70-06509

BIOLOGICAL EXTRACTION OF NUTRIENTS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06604

THE ROLE OF NITRATE NITROGEN IN BIOOXIDATION,
California Univ., Davis. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06607

THE EFFECT OF STERILIZATION TECHNIQUES ON WASTE WATER PROPERTIES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06610

IMPROVED METHODS FOR EVALUATION OF THERMAL DISCHARGE PRACTICES AND ALTERNATIVE ACTIONS,
Battelle-Northwest, Richland, Wash.
R. T. Jaske.
Institute of Environmental Sciences, 1970 Annual Technical Meeting, Proceedings, Boston, April 12-16, 1970, p 261-266. 6 fig, 9 ref.

Descriptors: Thermal discharges, Hydraulics, Temperature, Thermal capacity, Irrigation.
Identifiers: COLHEAT system, Temperature model, V-test.

COLHEAT, a deterministic stream temperature prediction system, describes the thermal regimen of a river or estuary and permits advance estimates of thermal effects of impoundments, single thermal plants, or an extended series of thermal and hydro installations with overlapping effects on a single or regionally combined watershed. The basic operation is a two step process: multiple shell or zonal transport system with adjustable allocation of inter- and intra-shell transport. Assuming that most streams will be turbulent and relatively homogeneous in hydraulic characteristics, the distribution of velocity contours within the stream will be similar for width to depth ratios exceeding 24. Based on this concept, the model sets up a series of difference equations and, using applicable budget methods based on continuity, iteratively computes the downstream temperatures as a function of the input parameters. In its initial operation, the rudimentary system was used to evaluate the manipulation of the discharges of Grand Coulee Dam, Deerfield River simulation, and on the upper Mississippi River Basin system with great success. The economics and technology of thermally elevated condenser discharges for agricultural usage bear critical examination. The study covering the operation of a 1000 MW thermal station discharging heated effluent into the distribution canal system of Phelps County, Nebraska, reveals that the present plant heat load is fully attenuated within the error measurement, plus or minus 0.5 C, in 25 miles of main canal. A 500 MW nuclear plant could be sited on the present system and the heat attenuated at the rate of 0.13 deg C per mile. (Upadhyaya-Vanderbilt)
W70-06635

A VIEW OF THE PROBLEM OF THERMAL POLLUTION, WITH SPECIAL REFERENCE TO THE WHITE RIVER IN INDIANA,
Indiana Univ., Bloomington. Water Resources Research Center.
M. A. Proffitt.
Institute of Environmental Sciences, 1970 Annual Technical Meeting, Proceedings, Boston, April 12-16, 1970, p 258-260. 6 ref.

Descriptors: *Thermal pollution, *Thermal discharge, Dissolved oxygen, Turbidity, Temperature, *Biochemical oxygen demand, *Fish, Indiana.
Identifiers: White River.

Six steam electric plants discharge into the approximately 350 mile length of the West Fork of White River. Their total capacity is 1100 megawatts, and their requirement for cooling water is estimated to be about 1250 cfs. The study at Petersburg has been a continuing survey of the fish and macroscopic invertebrates, together with measurements of temperature, oxygen, turbidity, and BOD. No evidence of organic pollution has been found. The 5-day BOD test has usually been in the 10-20 ppm range. Temperature 600 ft. downstream from the outfall are generally not more than 10 deg F above the ambient river temperature. Though more than 1000 tests have been made during five years, none have shown less than 6 ppm dissolved oxygen in the main stream. Turbidity is considerable and sometimes extremely high. It seems likely that the species of fish of importance at Petersburg can tolerate a temperature of 95 deg F for at least several days. Young fish are apparently just as resistant to high temperatures as adults, and perhaps more so. The 97 deg F mark was reached three times during the past decade in White River, and yet no fish kills ever reported. It is possible to develop temperature standards that will permit economical cooling by industry and yet protect the fishes and man's other river interest. (Upadhyaya-Vanderbilt)
W70-06642

THE BALANCE BETWEEN LIVING AND DEAD MATTER IN THE OCEANS,
Kiel Univ. (West Germany). Institut fuer Meereskunde.
For primary bibliographic entry see Field 02L.
W70-06652

DISPERSAL OF ALGAE, PROTOZOANS, AND FUNGI BY AQUATIC HEMIPTERA, TRICHOPTERA, AND OTHER AQUATIC INSECTS,
North Texas State Univ., Denton. Dept. of Biology.
Kenneth W. Stewart, Larry E. Milliger, and Bernard M. Solon.
Annals of the Entomological Society of America, Vol 63, No 1, p 139-144, 1970. 1 fig, 2 tab, 13 ref.

Descriptors: *Algae, *Protozoa, *Fungi, *Aquatic insects, *Dispersion, Caddisflies, Stoneflies, Dobsonflies, Mayflies, Cyanophyta, Chlorophyta, Chrysophyta, Chlorella, Rotifers, Chlamydomonas, Phytoplankton, Zooplankton, Periphyton.
Identifiers: *Hemiptera, *Trichoptera, Corixids, Eudorina, Notonectidae, Bodo, Hydropsychidae, Plecoptera, Magaloptera, Ephemeroptera, Nannochloris, Chloroccoccum, Microcystis, Fusarium, Trichorixa, Ramphocorixa, Sigara, Boenoa, Saldula, Cryncllus, Cheumatopsyche, Triaenodes in-

uusta, Oecetis, Leptocella, Isonychia, Caenis, Perlesta.

Of 16 species of aquatic insects studies (5 aquatic Hemiptera, 5 caddisflies, 1 stonefly, 2 dobsonflies, and 2 mayflies) 15 were found to be transporting 27 genera of viable small aquatic organisms. Three corixids carried 5 genera of blue-green algae, 11 green algae, 1 yellow-green alga, 2 protozoans, and fungi. Eudorina, representing colonial volvocalean algae, was found for the first time on field-exposed aquatic insects. Suitability of the Corixidae and Notonectidae as passive dispersal vehicles for small organisms is discussed. Only one of six caddisflies studied carried algae and protozoans, but that species, Hydropsyche orris Ross, carried 10 genera. Organisms taken in casual samplings of Plecoptera, Megaloptera, and Ephemeroptera are indicated. Excluding fungi, Chlorella was the most common viable form transported, followed by Bodo, Nannochloris, Chloroccoccum, and Microcystis, in order of frequency of occurrence. Unidentified fungi and Fusarium were carried by more than 75% of the 16 insects sampled and occurred in more than 50% of the 112 culture samples. These data further substantiate accumulating evidence that aquatic insects are among the most important overland passive transport vehicles for such organisms, contributing to their maintenance in, and distribution into, suitable isolated aquatic habitats. (Jones-Wisconsin)
W70-06655

AEROBIC HETEROTROPHIC BACTERIA INDIGENOUS TO pH 2.8 ACID MINE WATER: MICROSCOPIC EXAMINATION OF ACID STREAMERS,
Ohio State Univ., Columbus. Dept. of Microbiology.
Patrick R. Dugan, Carol B. MacMillan, and Robert M. Pfister.
Journal of Bacteriology, Vol 101, No 3, p 973-981, 1970. 14 fig, 17 ref.

Descriptors: *Aerobic bacteria, *Acid mine water, *Acid streams, Slime, Chemical analysis, Hydrogen ion concentration, Oxidation-reduction potential, Cytological studies, Microenvironment, Sulfates, Iron, Hydrogen, Appalachian Mountain Region, Ohio, Temperature, Sampling, Microscopy, Ultraviolet radiation, Electron microscopy.
Identifiers: *Acid streamers, Microcolonies, Polysaccharide stain, Escherichia coli, Aerobacter aerogenes, Extracellular fibrils, Freeze-etching, Hope Hollow Mine (Ohio), Phase-contrast.

Drainage from the highly acidic (pH 2.8) Hope Hollow Mine, Ohio, was selected for study because 'streamers' suspected to be of bacterial origin were observed in the water at the mine entrance. The 'acid streamers' consisted of bacteria trapped within an extracellular fibrillar polymer network. Inorganic compounds also precipitate within the polymer network. Several bacteria which appear to be divergent and are presumed to be different species are associated in the slimy mass of the 'acid streamers.' The 'streamers' contain individual microcolonies or microcosms that can be recognized by a selective polysaccharide stain, which suggests that the slime streamer is a conglomeration of polymers produced by more than one species. The organisms produce extracellular fibrils which adhere to form the matrix. The bacteria in streamers are not iron- or sulfur-oxidizing autotrophs. The question of nutrients to support the heterotrophs has not been thoroughly investigated, but low concentrations of nutrients are presumed to be present in acid water. Freeze-etching technique, as compared to carbon replication, for observation of extracellular fibrils and their ecological implications, is valuable. (Jones-Wisconsin)
W70-06667

TRANSFER OF RADIOISOTOPES BETWEEN DETRITUS AND BENTHIC MACROINVERTEBRATES IN LABORATORY MICROECOSYSTEMS,
Oak Ridge National Lab., Tenn. Radiation Ecology Section.
Jerry L. Wilhm.
Health Physics, Vol 18, No 3, p 277-284, 1970. 3 tab, 14 ref.

Descriptors: *Radioisotopes, *Detritus, *Benthic fauna, *Invertebrates, *Microenvironment, *Ecosystems, Cesium, Cobalt radioisotopes, Algae, Radioactivity, Trophic level, Life history studies, Time, Snails, Radioactive wastes, Tennessee, Crayfish, Midges, Gamma rays, Bloodworms, Sludge worms.
Identifiers: *Macroinvertebrates, Ruthenium-106, Cesium radioisotopes, Spirogyra, Limnodrilus hoffmeisteri, Stictochironomus annuliorus, Physa heterostropha, Procladius, White Oak Lake (Tenn), Uptake.

Ruthenium-106, cesium-137 and cobalt-60 transfer between detritus or algae and benthic macroinvertebrates was studied in laboratory microcosms. Detritus or algae containing radioisotopes was collected from a lake serving as settling basin for partially decontaminated waste water; four species of detritus feeders and one carnivorous specie were taken from a constant temperature spring. Mean initial activity in picocuries per ash-free grams in whole detritus was 28,800 for ruthenium-106, 6630 for cesium-137 and 6870 for cobalt-60, while values in Spirogyra were 135,000, 4930, and 62,100, respectively. Radioisotopes were present in intermediate concentrations in pulverized detritus. When whole detritus was used, activity of all three radioisotopes was greater in Limnodrilus hoffmeisteri than in Stictochironomus annuliorus; when pulverized detritus or algae was used as nourishment source, the reverse was true. Physa heterostropha was intermediate between Limnodrilus and Stictochironomus in activity. Peak concentrations of radioisotopes in detritus feeders were reached by day 3, while Procladius had delayed uptake, increasing in activity until day 14. Ruthenium-106 was detected in all life stages and exuviae of Stictochironomus; cesium-137 and cobalt-60 were detected only in larvae. Activity of ruthenium-106 in adults was 1/3 less than in larvae. (Jones-Wisconsin)
W70-06668

GROWTH RATE OF SPHAEROTILUS IN A THERMALLY POLLUTED ENVIRONMENT,
Indiana Univ., Indianapolis. Dept. of Microbiology.
Thomas L. Bott, and Thomas D. Brock.
Applied Microbiology, Vol 19, No 1, p 100-102, 1970. 2 fig, 8 ref.

Descriptors: *Growth rate, *Sphaerotilus, *Thermal pollution, *Environment, Ultraviolet radiation, Temperature, Microorganisms, Streams, On-site tests, Laboratory tests.
Identifiers: Generation time, Swarmer cells, Colonization.

A study was made of the growth and function of microorganisms in the natural environment, employing Sphaerotilus, a widespread organism in flowing waters, especially those subject to organic pollution. The test stream originates as a series of cold, hard water springs and receives thermal and organic pollution primarily in the form of steam condensate from a heating system and from the cooling water of a system manufacturing distilled water. The organism is sufficiently large and morphologically distinct to be recognized directly microscopically. In situ growth of Sphaerotilus on microscope slides immersed in the thermally polluted stream was observed. Ultraviolet radiation was used to differentiate between passive attachment from the water and growth of the organisms on slides. Colonization of the slides took place solely by means of swarmer cells. A generation time of 2.3 hours was obtained at a water temperature of 18 to 22C. It is invalid to assume, however, that colonization of new substrates will occur only by unicellular swarmer cells in all habitats. In a grossly polluted habitat, with much drift of filamentous Sphaerotilus masses, attachment and subsequent growth of filaments may occur. (Jones-Wisconsin)
W70-06669

DETERGENT ENZYMES: BIODEGRADATION AND ENVIRONMENTAL ACCEPTABILITY,
Monsanto Co., St Souis, Mo. Inorganic Chemicals Div.
For primary bibliographic entry see Field 05G.
W70-06673

EFFECT OF ENVIRONMENTAL FACTORS ON BENTHAL OXYGEN UPTAKE,
Pennsylvania State Univ., University Park. Dept. of Civil Engineering.
Archie J. McDonnell, and S. Douglas Hall.
Journal of Water Pollution Control Federation, Vol 41, No 8, Part 2, p R353-R363, 1969. 7 fig, 5 tab, 20 ref.

Descriptors: *Environmental effects, *Benthos, *Oxygen, *Dissolved oxygen, Invertebrates, Depth, Microenvironment, Temperature, Respiration, Biochemical oxygen demand, Scour, Diffusion, Pennsylvania, Density, Nitrogen, Tubificids, Worms.
Identifiers: *Uptake, Spring Creek (Pa), Total solids, Volatile solids, Chironomid larvae, Macroinvertebrates.

An attempt is made to define the relative effects--such factors as oxygen concentration, temperature, and character of the biologic community--have on the oxygen demand of benthal deposits sampled from a mildly polluted eutrophic stream. The macroinvertebrate population consisted primarily of tubificid worms and chironomid larvae. In benthal deposits containing large populations of macroinvertebrates, the oxygen concentration of the system may be lowered sufficiently by invertebrate respiration to depress the oxygen uptake attributed to the microbial populations. Results reinforce previous conclusions that oxygen uptake rates of benthal systems are dependent on oxygen concentration and temperature, and essentially independent of sample depth. The presence of measurable densities of macroinvertebrates proved significant to the characteristics of the benthal response. An attempt was made to approximate, by a relatively simple procedure, the demands associated with microbial and invertebrate respiration, thereby delineating the relative importance of each. Microbial respiration accounted for 48 and 45%, and invertebrate respiration 52 and 55%, of the benthal demand in the 2-centimeter and 25-centimeter samples, respectively. Such allocation for a given stream situation is necessary to the definition of engineering limits within which a stream model may be structured. (Jones-Wisconsin)
W70-06674

DIFFERENT TOXIC MECHANISMS IN KRAFT PULP MILL EFFLUENT FOR TWO AQUATIC ANIMALS,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
J. B. Sprague, and D. W. McLeese.
French Resume included. Water Research, Vol 2, p 761-765, 1968. 3 figs, 12 refs.

Descriptors: *Bioassay, *Atlantic salmon, *Lobsters, *Toxicity, *Biological treatment, Waste treatment, Water pollution effects.
Identifiers: *Bleached Kraft Mill effluent, Homarus americanus larvae, *Bio-oxidation, Toxicity changes.

Bleached kraft mill effluent (BKME) was reported to contain at least two different toxic mechanisms or materials which affect aquatic animals. BKME stored under clean and quiescent conditions, lost much of its toxicity for salmon parr (Salmo salar L.) in 1 week, and all in 2 weeks. By contrast, it lost

little toxicity to lobster larvae (Homarus americanus MilnesEdwards) in 2 weeks. Bio-oxidation of BKME for 1 week eliminated toxicity for salmon parr, but did not greatly change toxicity for lobster larvae. Bio-oxidation for 2 weeks reduced but did not eliminate toxicity to lobster larvae. A waste treatment process which reduces toxicity of BKME for one species may not protect other species. (Sjolseth and Katz-Washington)
W70-06691

MEASUREMENT OF POLLUTANT TOXICITY TO FISH I. BIOASSAY METHODS FOR ACUTE TOXICITY,
Fisheries Research Board of Canada, St. Andrews (New Brunswick). Biological Station.
For primary bibliographic entry see Field 05A.
W70-06692

OXYGEN UPTAKE RATE OF THE JAPANESE SPINY LOBSTER AS RELATED TO THE ENVIRONMENTAL OXYGEN CONCENTRATION,
Tokyo Univ. (Japan). Fisheries Inst.
Nimura Yoshihachiro, and Inoue Masaaki.
Bulletin of the Japanese Society of Scientific Fisheries, Vol 35, No 9, September 1969. p 852-861, 26 ref, 7 fig.

Descriptors: *Oxygen requirements, *Respiration, *Lobsters, Water temperature, *Animal metabolism, Diurnal, Animal behavior, Animal physiology.
Identifiers: *Panulirus japonicus, *Oxygen uptake rate, Active metabolic rate, Standard metabolic rate, Oxygen debt, Molting, Starvation, *Scope of activity.

The oxygen uptake rate was measured on the Japanese spiny lobster in relation to the ambient oxygen concentration and it was found that: (1) The rate increased near sunset and before sunrise, (2) the lobster paid the oxygen debt, (3) the standard metabolic rate (SMR) was constant at oxygen concentrations above the incipient lethal level, which was about 1.0 ml 0 sub 2/1 both in summer and winter, (4) the apparent SMR or low routine metabolic rate (RMR) was a double of SMR, and decreased in the range below 2.0-2.5 ml 0 sub 2/1, (5) the active metabolic rate (AMR) amounted to more than six times SMR, and decreased with the reduction of oxygen concentration in the range below 3-4 ml 0 sub 2/1, effect of temperature and body size on the SMR and AMR was evaluated, and the regression equations were obtained, (7) after molting the low RMR increased and fluctuated more widely, and (8) starvation did not change the RMR for two weeks. (Sjolseth and Katz-Washington)
W70-06693

DDT PERSISTENCE IN WILD HARES AND MINK,
Maine Univ. Orono. Dept. of Entomology.
J. A. Sherburne, and J. B. Dimond.
Journal of Wildlife Management, Vol 33, No 4, p 944-948, October 1969. 1 fig, 4 tab, 18 ref.

Descriptors: *DDT, *Pesticide residues, Chlorinated hydrocarbon pesticides, Mink, Gas chromatography, Maine, *Persistence, Forest soils, Food chains.
Identifiers: *Lepus americanus, *Mustella vison, *DDD, *DDE, Tissue analyses, Forest spraying.

Residue data in wild hares (Lupus americanus) and mink (Mustells vison) following light applications of DDT to the forest are presented. Residues of from 0.5 to 2.6 ppm DDT and its metabolites are shown to persist in mink up to 9 years after a single application of 1 lb/acre. Results of analyses of adult hares and hare fetuses show low residue levels throughout 10 years following spraying that are not significantly different (P 0.05 from levels found in hares from untreated forests. Patterns of DDT residue levels and persistence shown for these species are compared with similar patterns shown for other mammalian herbivores and predators. (Sjolseth and Katz-Washington)
W70-06694

SOME RELATIONS OF TEMPERATURE ACCLIMATION AND SALINITY TO THERMAL TOLERANCE OF THE BLUE CRAB, CALLINECTES SAPIDUS,
Bureau of Commercial Fisheries, Beaufort, N.C. Biological Lab.
Marlin E. Tagatz.
Transactions of the American Fisheries Society, Vol 98, No 4, p 713-716, Oct 1969. 1 tab, 2 fig, 12 ref.

Descriptors: *Thermal pollution, Thermal stress, *Acclimatization, Crabs, Water pollution effects, *Bioassay, Water temperature, *Salinity, *Toxicity.
Identifiers: *Blue Crab, Callinectes sapidus, Median tolerance limit, *Thermal tolerance, *Temperature acclimation.

The 48 hour median thermal tolerance limits of adult and juvenile blue crabs in relation to salinity and preceding acclimation temperature were estimated from experimental data. Crabs were less tolerant to temperature extremes at low salinity, and at both low (6.8%) and high (34%) salinities, the upper and lower tolerance limits increased as the acclimation temperature increased. Almost all 48 hr TLm in 6.8% water were 0.2 to 2.0C less than those for crabs in 34% sea water. Lethal temperatures produced initial heat shock which was characterized by loss of equilibrium and erratic and rapid swimming. No sexual differences in thermal tolerance were observed. (Sjolseth and Katz-Washington)
W70-06695

EFFECTS OF 'SOFT' DETERGENTS ON EMBYROS AND LARVAE OF THE AMERICAN OYSTER (CRASSOSTREA VIRGINICA),
Bureau of Commercial Fisheries, Milford, Conn.
Anthony Calabrese, and Harry C. Davis.
1966 Proceedings of the National Shellfisheries Association, Vol 57, p 11-16, June, 1967. 3 tab, 6 ref.

Descriptors: *Linear Alkylate Sulfonates, *Detergents, Bioassay, *Oysters, Mortality, *Toxicity, Growth rates, Sewage effluents, *Larvae, Embryonic growth stage, Larval growth stage, Marine fisheries.
Identifiers: *Crassostrea Virginica, Detergent degradation products development.

Experiments were designed to determine the toxicity to oyster embryos and larvae of a standard linear alkylate sulfonate (LAS) detergent, a commercial liquid LAS detergent, and sewage effluent with and without degradation products of LAS. The percentage of fertilized eggs developing normally was reduced significantly at concentrations greater than 0.025 mg/l of the standard LAS and 0.25 mg/l of the commercial detergent. The percentage survival and growth of larvae decreased significantly at 1.00 and 0.50 mg/l, respectively, for LAS and at 2.50 mg/l for the liquid detergent. Although growth of oyster larvae was decreased by concentrations of 100 ml per liter of effluent with or without LAS, the reduction was not drastic except at concentrations of 200 ml per liter or higher. The toxicity, if any, of the degradation products of LAS was masked by the toxicity of the effluent itself. (Sjolseth and Katz-Washington)
W70-06696

EVALUATION OF LAMPREY LARVICIDES IN THE BIG GARLIC RIVER AND SAUX HEAD LAKE,
Bureau of Commercial Fisheries, Marquette, Mich.
Patrick J. Manion.
Journal of the Fisheries Research Board of Canada, Vol 26, p 3077-3082, 1969. 2 tab, 1 fig, 7 ref.

Descriptors: *Ammocetes, *Laruicides, *Lampreys, Michigan, Fish control agents, Fish populations, Mortality, Census, Fish migration, Evaluation.
Identifiers: *Bayluscide, *TFM, *Petromyzon marinus, Saux Head Lake, Michigan, Big Garlic River, Synergism.

Bayluscide (5,2'-dichloro-4'-nitrosalicylanilide) and TFM (3-trifluoromethyl-nitrophenol) were evaluated as selective larvicides for control of the sea lamprey, Petromyzon marinus, in the Big Garlic River and Saux Head Lake in Marquette County, Michigan. Population estimates and movement of ammocetes were determined from the recapture of marked ammocetes released before chemical treatment. In 1966 the estimated population of 3136 ammocetes off the stream mouth in Saux Head was reduced 89% by treatment with granular Baylucide; this percentage was supported by a population estimate of 120 ammocetes in 1967, an indicated reduction of 96% from 1966. Postmarking movement of ammocetes was greater than downstream. (Sjolseth and Katz-Washington)
W70-06697

5D. Waste Treatment Processes

DETERMINATION OF DEGRADED DYES AND AUXILIARY CHEMICALS IN EFFLUENTS FROM TEXTILE DYEING PROCESSES,
Georgia Inst. of Tech., Atlanta. Environmental Resources Center.
For primary bibliographic entry see Field 05A.
W70-06316

MINE WATER RESEARCH: PLANT DESIGN AND COST ESTIMATES FOR LIMESTONE TREATMENT,
Bureau of Mines, Pittsburgh, Pa. Coal Mining Research Center.
Edward A. Mihok.
Bureau of Mines Report of Investigations 7368, April 1970. 13 p, 1 fig, 7 tab.

Descriptors: *Acid mine water, *Water pollution treatment, *Water pollution control, Waste water treatment, Neutralization, Limestones, Aeration, Settling basins, Sludge.
Identifiers: Acid mine water treatment.

Plant design and cost estimates for limestone treatment of acid mine water covering a wide range of quality and quantity conditions are presented. The treatment process consists of limestone neutralization, aeration, solids settling, and concentration. The design criteria for the various operation functions are based on pilot plant performance, laboratory data, and established mine water treatment standards. Unit costs are assumed and are related to general market prices and conditions. These estimates serve as preliminary indicators of what it would cost to construct and operate a mine water treatment plant. (Knapp-USGS)
W70-06532

MASTER WASTEWATER COLLECTION AND TREATMENT PLAN FOR BOGOTA, COLOMBIA,
Kamp, Dresser, and McKee.
David R. Horsefield.
Journal Water Pollution Control Federation, Vol 40, No 8, p 1443-1458, Aug 1968. 9 fig, 3 tab, 1 ref.

Descriptors: *Sewage treatment, *Planning, *Design, Waste water treatment, Flows, Construction, Costs, Treatment, Sewers.
Identifiers: *Bogota, Combined sewers, Loading.

Bogota, the capital city of Colombia is located on the Andes Mountain plateau and has a population of 1,700,000. The average waste water flow of 88.2 million gallons a day is expected to increase with an estimated 1985 population of 3,200,000. A master plan is established recommending the construction of sewers and canals to convey combined wastes to points of treatment prior to discharge to Rio Bogota. The first stage program, ($11,000,000.00)

presently is underway. The entire project will cost $85,000,000. Problems encountered and methods used in design criteria are discussed. (Hancuff-Texas)
W70-06579

DISPOSAL AND RECOVERY OF ELECTROPLATING WASTES,
North Carolina Univ., Chapel Hill.
George E. Barnes.
Journal Water Pollution Control Federation, Vol 40, No 8, p 1459-1470, Aug 1968. 10 fig, 5 tab.

Descriptors: *Industrial wastes, *Treatment, *Chlorination, Waste water treatment, Cost, Sewage treatment, Coatings, Metals, Waste water, Lagoons.
Identifiers: *Electroplating, Plating, Metal protection, Cyanides, Chemical removal, Recovery, In-plant survey.

Destruction and recovery are two major methods of electroplating waste disposal. Recovery demands more elaborate control of rinsing procedures since the goal is to concentrate first rinses to the point where they can be returned to the plating baths as makeup. This can save money over chemical treatment such as chlorination of the wastes. Other considerations to be made when deciding between recovery versus destruction are piping valves, pumps, accumulation tanks, chemical storage and feeding equipment, controls, sludge storage tanks, tank trucks, and lagoons. The matter of sludge handling and lagooning in some localities may be a serious deterent to adoption of the destruction process. (Hancuff-Texas)
W70-06580

VERSATILITY AND EXPANDABILITY OF PRETREATMENT,
Stanford Univ., Calif.
Rolf Eliassen, and Dean F. Coburn.
Journal of the Sanitary Engineering Division, ASCE, Vol 95, No SA2, p 299-310, April 1969. 2 fig, 4 tab, 3 ref.

Descriptors: *Waste water treatment, *Water treatment, Planning, Design, Treatment facilities, Flotation, Aeration, Screens, *Pre-treatment (Water).
Identifiers: Unit processes.

Pretreatment processes are designed to precondition water and waste water for subsequent operations. Processes for water include watershed management, reservoir storage, screening, sand traps, aeration, and chemical treatment. Pumps, racks, grinding, grit removal and washing, preaeration, flotation, and chemical treatment are used for waste water. The combination of processes varies with each installation, but depends largely on the characteristics of the raw water and waste water and the degree of treatment to be provided. Planning and designing for pretreatment must be based on a detailed understanding of the processes and their functions. A good design must meet the immediate and the future treatment objectives, and allow for changes and future expansion in treatment units and processes. (DiFilippo-Texas)
W70-06581

REMOVAL OF NEMATODES BY RAPID SAND FILTRATION,
Illinois Univ., Urbana.
Irvine Wen-Tung Wei, R. S. Engelbrecht, and John H. Austin.
Journal of the Sanitary Engineering Division, Proceedings of the American Society of Civil Engineers, Vol 95, No SA1, February 1969, p 1-16, 10 fig, 4 tab, 12 ref.

Descriptors: *Nematodes, *Filters, *Water pollution, Worms, Filtration, Pre-treatment (Water), Waste water treatment.
Identifiers: *Nematode removal, *Sand filters, Motility, Filtration time, Sand size, Nematode balance, Hydraulic resistance.

Experimental methods have been adopted to obtain information on the mechanism of nematode removal by rapid sand filtration and to study the role of motility. In order to confirm the existing practice, effective sizes and uniformity coefficients were selected on the criterion for the preparation of sand. A filtration time of 8 hours was selected for most of the studies. The study reveals that with a low percent nematode motility, the removal of nematodes increases with decrease in sand size. The penetration of nonmotile nematodes increased as the hydraulic resistance of the filter decreased. It was further determined that most of the nematodes could penetrate the filter bed although they were temporarily retained in the sand during the early stages of filtration. These motile nematodes also cause serious dislodgement of the non-motile nematodes initially removed by the filter. The above two phenomena result in an overall decrease in the removal of nematodes. Chemical pre-treatment method could reduce the dislodging effect, but not very significantly. (Shankar-Texas)
W70-06582

EVALUATION OF ANAEROBIC DENITRIFICATION,
Metcalf and Eddy, Inc., Palo Alto, Calif.
D. F. Seidel, and R. W. Crites.
Journal of the Sanitary Engineering Division, Proceeding of the ASCE, Vol 96, No SA 2, p 267-277, April 1970. 7 fig, 1 tab, 8 ref.

Descriptors: *Anaerobic digestion, *Denitrification, *Filters, Pilot plants, Laboratory test, Anaerobic bacteria, Nitrates, Waste water treatment, Sewage treatment, Waste treatment.
Identifiers: Upflow, Horizontal flow, Media.

Several methods of removing nitrogen from sewage effluents by anaerobic denitrification were evaluated. An upflow anaerobic filter containing gravel media (1 in. to 1.5 in) was used to denitrify a municipal wastewater which contained an average of 14 mg/l nitrate nitrogen. Results obtained from pilot plant studies using methanol as a supplementary carbon source for the denitrifying bacteria showed 90% nitrogen removal with a detention time as short as 1.5 hours. Laboratory studies were also conducted utilizing upflow and horizontal flow filters containing a fiber media composed of a Dynel fiber coated with neoprene resin and bonded to a fiberglass mesh. This highly porous fiber media performed comparably to the gravel media in the upflow filter as 88% nitrate nitrogen removal was obtained with a detention time of 2 hours. However, media configuration and poor flow distribution limited the success of the horizontal flow filters. Several advantages of the anaerobic filter process for denitrification such as, low initial and operating cost, simplicity of operation, long solids retention times, and absence of any sludge recycle or disposal equipment were presented. The cost of methanol was the major operating expense for the process. The quantity of methanol required increases with increasing dissolved oxygen and nitrate nitrogen and decreasing effluent BOD. The total cost not including the cost of nitrifying the secondary effluent and reaerating the denitrified effluent was estimated as low as $12.00 per million gallons. (Galwardi-Texas)
W70-06583

AEROBIC BACTERIOLOGY OF WASTE STABILIZATION PONDS,
Oklahoma Univ. Medical Center, Oklahoma City. Inst. of Environmental Health.
J. D. Gann, R. E. Collier, and C. H. Lawrence.
Journal of the Water Pollution Control Federation, Vol 40, No 2, p 185-191, Feb 1968. 1 fig, 2 tab, 12 ref.

Descriptors: *Aerobic treatment, *Lagoons, *Microbiology, Bacteria, Dissolved oxygen, Microorganisms, Organic loading, *Waste water treatment.
Identifiers: *Bacteriology, *Experimental units, Achromobacter, BOD removal, Flavobacterium, Nitrogen reduction, Pseudomonas.

As assessed by morphological and physiological investigations, the flora of laboratory and field ponds consisted primarily of Gram-negative, rod-shaped bacteria generically identified as Achromobacter, Pseudomonas, and Flavobacterium. Together the members of these genera constituted 90 to 95% of the total count. The physical, chemical, and metabolic requirements of this group were found to be compatible with the temperature, variable DO, alkaline pH, and proteinaceous substrate found in stabilization ponds. Their reactions were found to be in agreement with the observations of pond characteristics and performance. Their occurrence in dominant proportions under a variety of operational conditions indicate that these organisms were primarily responsible for the treatment of domestic wastes in the stabilization ponds studied. The experimental waste stabilization ponds were operated at a loading of 30 lbs BOD/ac/d which resulted in an operational efficiency of 93% in BOD reduction. The greatest part of the treatment was achieved in the immediate vicinity of the influent. (Aguirre-Texas)
W70-06584

ANAEROBIC LAGOON TREATMENT OF MILKING-PARLOR WASTES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Raymond C. Loehr, and John A. Ruf.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 83-94, Jan 1968. 5 fig, 4 tab, 14 ref.

Descriptors: *Anaerobic conditions, *Industrial wastes, *Lagoons, Dairy industry, Animals, Biochemical oxygen demand, Coliforms, Efficiencies, Sewage treatment, Sludge, *Waste water treatment.
Identifiers: *Dairy cattle, *Field study, Milking parlor, Waste characteristics.

A field study of an 80-cow milking parlor and its waste treatment facilities determined that the average flow and BOD5 of the milking parlor waste were 760 gpd (2870 l/d) and 1030 mg/l. The flow varied considerably through the day. The first cell was loaded at 9 lbs BOD5/d/1000 cuft (144 g BOD5/d/cu.m). The summer BOD reduction was 85% while during the winter it was only 70%. The BOD5 of the supernatant from the second cell during the summer ranged from 50 to 100 mg/l. Removal of solids from the lagoons during cold weather adversely influenced the performance of the lagoons. Solids assumulated in the first cell during winter and were degraded during spring. Coliform reductions in the system exceeded 99%. (Aguirre-Texas)
W70-06585

MATERIALS OF CONSTRUCTION FOR TRADE WASTE TREATMENT PLANTS,
Prodorite Ltd., Birmingham (England).
For primary bibliographic entry see Field 08G.
W70-06586

SEWAGE PLANT DESIGNED FOR FLUCTUATING POPULATION,
Nebolsine, Toth and McKee, Fort Lee, N.J.
Arnold R. Smith.
Water and Wastes Engineering, Vol 7, No 1, p 40-41, Jan 1970. 3 fig.

Descriptors: *Design, *Aerobic treatment, *Construction costs, *Cost comparisons, *Treatment facilities, *Equipment, Aeration, Treatment, Waste water treatment, Sewage treatment, Settling basins, Activated sludge.
Identifiers: *Primary clarifiers, *Savings (Equipment and construction), *Aerobic digestion, *Contact stabilization, Duquesne (Penn), Duquesne Sanitary Authority (Penn), Contact chlorination, Recycling (Sludge), Re-aeration.

Plant design description is presented of a 2 mgd wastewater treatment plant at Duquesne, Pennsylvania. Design differs from conventional type; it provides for tanks one-third smaller than standard

size and the facilities using contact stabilization and aerobic digestion are adaptable to meet rapid, seasonal or fluctuating demands, such as encountered due to population changes in resort towns. Operational flexibility and construction savings are discussed. Other important departures from conventional treatment are: Primary settling is eliminated; and, the volatile content of sludge is reduced in order to dispose of its solids. The specific modifications in process and equipment design which pertain to these departures are described briefly. Equipment and space requirements are greatly reduced due to the smaller tanks and use of common wall construction for contact stabilization and aerobic digestion. The key to the low-cost operation is the series of 8 identical tanks (2 for contact aeration of raw sewage, 2 for sludge stabilization, 3 for aerobic digestion, 1 for standby); any tank can be used for any part of the process, and the number of tanks used can be varied to meet changing demands. The plant can be run at design capacity of 2 mgd or at any fraction thereof without loss of treatment efficiency. (D-'Arezzo-Texas)
W70-06587

BIOLOGICAL ASPECTS OF ORGANIC WASTE TREATMENT,
Bath Univ. of Technology (England).
R. G. Board.
Water Pollution Control, Vol 67, No 6, p 614-621, 1968. 4 fig, 2 tab, 38 ref.

Descriptors: *Bacteria, *Biological properties, *Organic wastes, *Microorganisms, Metabolism, Disposal, Incineration, Dispersion, Dilution, Oxidation lagoons, Activated sludge, Filtration (Biological), Fermentation, Oxygenation, *Waste treatment.
Identifiers: *Protocaryotic cell, *Eucaryotic cell, *Cell structure, *Cell function, *Organic waste treatment, *Microbial kinetics, Bacterial metabolism, Pseudomonads, Macro-organisms, Composting, Wet air oxidation, Violent agitation, Lagoons, Pasveer method.

A description is given of the structure and function of a bacterial cell typical of those that carry out waste degradation, and the suggestion is made that the kinetics of microbial growth should be given greater emphasis in the development of waste water treatment processes. The mechanics and metabolism of accepted disposal methods are examined, including: incineration, dispersion, separation, dilution, composting, oxidation ponds, lagoons, violent agitation, biological filters, and fermentation. In most organic waste treatment methods, micro-organisms, especially bacteria are agents of primary importance. Major structural properties of the bacterial (protocaryotic) cell are described and contrasted with plant and animal (eucaryotic) cells. Functional physiological similarities of cells are explained. While the kinetics of microbial growth has experienced major advances in micro-biology, the full benefits of this knowledge has not been realized in the design and operation of waste treatment plants. However, while with one organism growing in a defined medium, the kinetics of growth can be established with a fair degree of accuracy, this information is of limited value when confronted with heterogeneous bacterial populations exposed to an undefined and variable supply of nutrients. This fact compels extensive laboratory tests before practical modifications can be made in plant and operational procedures. (D'Arezzo-Texas)
W70-06588

THE CONTROL AND TREATMENT OF TRADE EFFLUENTS,
Greater London Council, London (England).
John Griffiths.
Water Pollution Control, Vol 67, No 6, P 606-611, 1968.

Descriptors: *Effluents, *Control systems, *Treatment, *Industrial wastes, Industries, Disposal, Pretreatment (Wastes), Solid wastes, Costs.
Identifiers: *Trade effluents, *Food factories, *Treatment charges, *Mogden-type cost treatment formula, pH control, Solids removal, Lime, Soda ash, River authority.

Needs, means, and principles of treatment and control of food factory effluents are discussed. Satisfactory degrees of control mentioned were: solids removal up to 1500 mg/l, pretreatment of grease, and oil, pH control by lime or soda ash addition to acid discharge, and provision of petrol/oil interceptors. The imposition of charges by a local authority for the treatment of trade effluents is discussed. The so-called 'Mogden-type' formula for determining the cost of treatment has encountered considerable difficulty in actual applications. It cannot be applied equitably to both small and large industries. Also, insofar as types of industries are concerned the formula is troublesome to apply. Special discussions ensued by symposia attendees regarding emphasizing problems created by the wide variation in trade effluents, the efficacy of treatment and, the relative merits of the Modgen-type cost formula. The trend is toward seeking a rational basis for treatment cost imposed on industry. (D'Arezzo-Texas)
W70-06589

A REVIEW OF POULTRY WASTE DISPOSAL POSSIBILITIES,
Ministry of Agriculture, Fisheries and Food, London (England).
For primary bibliographic entry see Field 05E.
W70-06590

FARM WASTE DISPOSAL IN RELATION TO CATTLE,
National Agricultural Advisory Service, London (England).
For primary bibliographic entry see Field 05E.
W70-06591

REVERSE OSMOSIS OFFERS USEFUL TECHNIQUE FOR DESALTING,
Office of Saline Water, Washington, D.C.
K. C. Channabasappa.
Water and Wastes Engineering, Vol 7, No 1, p A5-A8, Jan 1970. 3 fig, 3 tab.

Descriptors: *Osmosis, *Membrane process, *Desalination, *Municipal wastes, *Industrial wastes, Industrial water, Agriculture, Sewage treatment, Water supply, Water reuse, Water demand.
Identifiers: *Reverse osmosis, *Membrane technology, *Costs (Treatment), *Costs (Water), *Capital costs, *Plant designs, *Waste reuse economics, By-product recovery, Quality standards (Effluents), Brackish water analysis.

Two potential sources from which future industrial and agricultural water needs can be obtained are municipal sewage and industrial wastes. Formerly, the high cost of treatment of these sources precluded reuse. With the osmosis process, however, both municipal and industrial wastes can be treated to provide industrial water at 25 to 35 cents/1000 gals. Expected advances in membrane technology in the next 5 years may lower costs to 15-20 cents/1000 gals. Whether it is economical to get additional industrial water by desalination of sewage or industrial wastes or both must be based on: (1) cost and availability of alternate water sources; (2) actual cost of treating sewage or industrial wastes by desalination processes; (3) the value of by-product recovery; (4) cost savings accruing from lesser volumes of wastes to be discharged. The prospects and potentialities of desalination of wastes to obtain additional water for industrial and agricultural uses, warrant closer study as water demands increase and effluent water quality standards become more stringent. (D'Arezzo-Texas)
W70-06592

TECHNOLOGIES IN COAGULATION,
Bissell, Bronkie and Associates, Williamsville, N.Y.
William H. Merrill, Jr.
Water and Wastes Engineering, Vol 7, No 1, p 42-43, Jan 1970. 2 p.

Descriptors: *Coagulation, *Zeta potential, *Flocculation, *Treatment, *Wastes, *Waste water disposal, Sedimentation, Adsorption, Viscosity, Filtration.
Identifiers: *Flotation, *Chemical treatment, *Floc formation, *Settling, *Polyelectrolytes, Neutralization of electric charges, Organic coagulants, Organic chemicals, Electrical field, Sludge thickening, Pollution abatement.

The processes of coagulation or flocculation are explained to insure a more basic understanding by the engineer in his application of these processes to wastewater control. Coagulation may be considered as a chemical treatment differing from purely physical or biological treatments. However, this distinction cannot be adhered to rigorously since the three enumerated treatments are not practically separable in the comprehensive treatment process. The study explains the practical joint usages of coagulation and sedimentation. Several mechanisms involved in coagulation are explained including: settling of precipitates and entrapment of material, neutralization of electric charges, and floc formation. The various chemicals normally used in coagulation are identified and evaluated. The use of organic chemicals to effect coagulation is relatively new. Various types are described and evaluated, including: non-ionic binder types, polyelectrolytes of the polymeric type. The relatively higher costs and special problems created by polyelectrolytes are explained. Certain special uses of coagulation are explained, notably: flotation, sludge thickening and filtration. New techniques based on more effective application of the Zeta potential concept are feasible. It is now possible to measure the potential and use the measurements for improving coagulation. (D'Arezzo-Texas)
W70-06593

SLUDGE TREATMENT AND DISPOSAL AT THE BROCKHURST WORKS OF THE UPPER TAME MAIN DRAINAGE AUTHORITY,
Upper Tame Main Drainage Authority, Birmingham (England).
B. R. Edmondson.
Water Pollution Control, Vol 68, No 2, p 146-165, March-April, 1969. 11 fig, 7 tab, 1 ref.

Descriptors: *Sludge disposal, *Costs, Lime, Design, Operations.
Identifiers: *Polyelectrolytes, *Press plant, *Sludge conditioning, Copperas.

The Brockhurst works handles a 6.25 mgd dry weather flow, of which 2.25 mgd is trade effluents. A sludge pressing plant was installed to supplement drying beds and lagoons. The plant was designed to handle 122,500 gallons of digested sludge containing 4.5 percent dry solids and 192,500 gallons of primary and humus sludges containing 6.0 percent dry solids during a five day week. Description is given concerning the design and operation of the plant which utilizes lime and copperas as conditioning agents. Prior to installation of the plant Buchner-funnel tests were run using lime and copperas, and aluminum chlorohydrate as conditioning agents. Lime and copperas was found to be the most effective. This result was verified by tests using a 12 inch square, single plate press. Twenty nine polyelectrolytes were also investigated. Several polyelectrolytes reduced the specific resistance to an acceptable level but only two or three were competitive in cost. None of the polelectrolytes was sufficiently effective on digested sludge and two reagents were effective on humus sludge. Data are presented on the performance of several polyelectrolytes. Capital and operational cost data are given. (DiFilippo-Texas)
W70-06594

EXPERIENCE WITH A WAGE INCENTIVE BONUS SCHEME AT GOSCOTE AND BROCKHURST SEWAGE WORKS,
For primary bibliographic entry see Field 06C.

W70-06595

ROLE OF ACTIVATED SLUDGE FINAL SETTLING TANKS,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Richard I. Dick.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No SA2, p 423-436, April 1970. 10 fig, 17 ref.

Descriptors: *Activated sludge, Sewage treatment, Sedimentation, *Waste water treatment.
Identifiers: *Thickening, *Final settling tank, *Flux rate, Clarification, Suspended solids.

The final settling tank in the activated sludge process has two functions: clarification and thickening. Conventional design procedures have considered only the clarification function. However, inadequate performance of thickening functions produces adverse effects, including: loss of suspended solids to the effluent and insufficient suspended solids concentration in the sludge recycle which leads to lower mixed liquor suspended solids concentrations in the aeration tank. To assure proper performance of the final settling tank the tank should be sized for each function and the larger size should govern the design. The area required for thickening must be sufficient so that solids are applied to the tank at a rate less than the rate at which solids are able to reach the bottom of the tank. The rate at which biological solids reach the bottom of the tank is termed the flux rate. Characteristically, this flux rate passes through a minimum for some concentration of activated sludge present in the settling tank. This minimum flux rate acts as a bottleneck and governs the area required for thickening. Several methods for determining the limiting capacity are given in an illustrative example. (DiFilippo-Texas)
W70-06596

EFFECT OF DISSOLVED OXYGEN CONCENTRATION ON THE METABOLIC RESPONSE OF COMPLETELY MIXED ACTIVATED SLUDGE,
Oklahoma State Univ., Stillwater. Dept. of Civil Engineering.
G. J. Tharbaraj, and A. F. Gaudy, Jr.
Journal of the Water Pollution Control Federation, Vol 41, No 8, Part II, p R322-R335, August, 1969. 6 fig, 3 tab, 29 ref.

Descriptors: *Activated sludge, *Dissolved oxygen, Chemical oxygen demand, Sewage treatment, Metabolism, Waste water treatment.
Identifiers: *Shock load, Transient behavior, Steady state.

Steady state conditions were established in laboratory activated sludge units at specific levels of dissolved oxygen (7.2, 7.4, 3.2, and 1.3 mg/l), the concentration of substrate in the feed was increased, observation was made of the transient and new steady state behavior, and in some cases substrate concentration was reduced to the original level and observation made of the transient and new steady state. Steady state valves of respiration rate, substrate channelled into respiration, solids yield, COD removed per weight of ammonia consumed, and protein and carbon-hydrate concentration of cells were found to be independent of dissolved oxygen concentration in the range studied (0.4 to 7.4 mg/l). The transient response consisted of two distinct sequential responses. The first was a metabolic or physiological reaction carried out by the population present prior to the shock. During this initial response lower dissolved oxygen levels gave rise to higher COD in the effluent. The second transient response involved a change in the predominate population; gave rise to increased COD, solids and intermediates in the effluent, and was independent of dissolved oxygen concentration. (DiFilippo-Texas)
W70-06597

OXYGEN DEMAND AND SUPPLY IN AN ACTIVATED SLUDGE PLANT,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
K. L. Schulze, and R. D. Kooistra.
Journal of the Water Pollution Control Federation, Vol 41, No 10, p 1763-1774, October 1969. 12 fig, 11 ref.

Descriptors: *Activated sludge, *Oxygen requirements, *Aeration, Biochemical oxygen demand, Sewage treatment, Dissolved oxygen, *Waste water treatment.
Identifiers: Oxygen uptake rates.

Mixed liquor oxygen consumption rates, r sub r, specific oxygen consumption rates, K, and BOD of primary effluent were measured during the fall and summer academic terms at the first bay of a three-bay activated sludge aeration tank series. Hourly and daily fluctuations in both r sub r and K sub r were quite similar to fluctuations in BOD. The similarity of fluctuations of r sub r and K sub r indicated that changes in r sub r essentially were caused by changes in the physiological activity of the floc and not simply changes in mixed liquor suspended solids concentration. While oxygen uptake rates of 9 mg/l/hr to 42 mg/l/hr and 32 mg/l/hr to 90 mg/l/hr were observed during the summer and fall respectively, aeration equipment was found capable of providing dissolved oxygen at a rate of 22.5 mg/l/hr. Thus the aeration equipment acted as a limiting factor and slowed down the process. It is concluded that for a relatively inflexible and low rate oxygen supply, as provided by most aeration equipment, it would be advantageous to strive for complete mixing conditions. (DiFilippo-Texas)
W70-06598

KINETICS OF OXYGEN UPTAKE BY DEAD ALGAE,
Howard Univ., Washington, D.C. Dept. of Civil Engineering.
Man M. Varma, and Francis DiGiand.
Journal of the Water Pollution Control Federation, Vol 40, No 4, p 613-626, April 1968. 11 fig, 6 tab, 16 ref.

Descriptors: *Age, *Algae, *Biodegradation, *Oxygen demand, Laboratory tests, Lagoons, Oxidation, Photosyntheses, Plants, Temperature, *Waste water treatment.
Identifiers: *Uptake, Cells, Concentration, Composition, Material balances, Organisms.

The rate of oxygen uptake by dead algal cells is independent of the algal cell concentration. The rate of uptake by young cells is greater than that by old cells. Rates increase with temperature up to about 35 deg C, then decrease sharply. Increased bacterial population will increase the biodegradation of the dead algae. Uptake rates observed ranged from 0.008 micro l 0 sub 2/min/mg algae for old cells at 20 deg C to 0.294 micro l 0 sub 2/min/mg algae for young cells at 35 deg C. Material balances showed that the total actual oxygen uptake was less than the total oxygen required for complete degradation of the substrate because oxidation was incomplete. (Aguirre-Texas)
W70-06600

OVERLOADED OXIDATION PONDS--TWO CASE STUDIES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
Ross E. McKinney.
Journal of the Water Pollution Control Federation, Vol 40, No 1, p 49-56, Jan 1968. 9 tab, 7 ref.

Descriptors: *Aeration, *Algae, *Lagoons, *Oxidation lagoons, Biochemical oxygen demand, Chemical oxygen demand, Dissolved oxygen, Odor, Organic loading, *Waste water treatment.
Identifiers: *Aeration tubes, *Diffusers, *Raytown (Mo), Lee's Summit (Mo), Oxygen transfer, pH, Suspended solids.

The use of a diffused aeration system as a means of increasing the capacity and improving the performance of overloaded oxidation ponds was evaluated in a one year dual study of the ponds at Lee's Summit and Raytown, Mo. The supplemental aeration system consisted of polyethylene tube diffusers, a common header, and an air compressor. Data accumulated during the test period include BOD, COD, suspended solids, pH, and dissolved oxygen. Biochemical oxygen demand (BOD) and COD removal averaged 80% and 54% at Lee's Summit, respectively. The pond covered 25 acres, with an average depth of 5 feet and an average detention period of 30 days. The BOD5 load to the pond was estimated to be 2550 lbs/day. The oxidation pond at Raytown consisted of a first-stage aerated lagoon with two 15-HP aerators followed by a second-stage lagoon, where the plastic aeration tubing was installed, estimated to receive an organic load of 1000 lbs BOD5/day. Organic removal efficiencies were similar to the Lee's Summit system as a statistical basis. The plastic tubing aeration units can produce an effluent under 30 mg/l BOD5 at a loading of 1000 people/d/ac. But, the study indicates that the aeration tubing should be used with caution. It can assist overloaded oxidation ponds by improving mixing, but is not a cure-all. Clogging of the aeration tubing was a problem relieved by treatment with hydrochloric acid, and the basic mechanism of treatment was increased algal metabolism through better mixing rather than direct oxygen transfer. (Aguirre-Texas)
W70-06601

REGIONAL MANAGEMENT OF WATER QUALITY--A SYSTEMS APPROACH,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
Melvin W. Anderson, and H. J. Day.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1679-1687, Oct 1968. 4 fig, 1 tab, 8 ref.

Descriptors: *Management, *System analysis, *Sewage treatment, *Computers, *Dissolved oxygen, Analysis, Biochemical oxygen demand, Costs, Operational costs, Planning, Streams, Water Pollution Control, *Waste water treatment.
Identifiers: *Miami River (Ohio), Stream pollution.

A modified Streeter Phelps Equation was adapted to linear programming to study ways of minimizing regional operation costs for a number of waste water treatment plants on a river subject to water quality standards. The region studied was a warm Miami River valley in Ohio from Dayton to New Baltimore. The parameters considered in the optimization technique are: (1) number and length of reaches and location of waste outfalls, (2) waste loadings received by treatment facilities, (3) treatment available at each outfall, (4) operating cost of each waste treatment facility, (5) quantity and quality of tributary flows, (6) deoxygenation coefficients, (7) reoxygenation coefficients, (8) velocity of river in each reach, (9) temperature of river in each reach, (10) river standards of desired level (DO), and (11) initial conditions of river prior to first reach. Results indicate that higher dissolved oxygen levels in a river can be obtained at reduced operating costs. It is also possible to suggest where future waste water treatment facilities should be located to obtain maximum benefits. (Hancuff-Texas)
W70-06602

BIOLOGICAL EXTRACTION OF NUTRIENTS,
Michigan Univ., Ann Arbor. Dept. of Civil Engineering.
Jack A. Borchardt, and Hardam S. Azad.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1739-1754, Oct 1968. 13 fig, 22 ref.

Descriptors: *Algae, *Phosphorus, *Phosphates, Energy, Di-urnal distribution, Temperature, Metabolism, *Waste water treatment, Light, Microorganisms, Plants.

Identifiers: *Biological extraction, Growth, Shock loading.

Studies of phosphate uptake from synthetic secondary waste water by algae in continuous-culture laboratory units showed three regimes of phosphate uptake: (1) growth dependent on phosphate concentration below 0-1.5 mg/l phosphate (0-3% of algal dry weight), (2) storage of phosphate at 1.5 to 4.5 mg/l (3-9%), and (3) saturation at phosphate levels greater than 4.5 mg/l (9%), at an organism density of 50 mg/l. At 15 mg/l the growth rate also declined when phosphate concentration was lowered beyond 3% of the algal dry weight. As temperatures become lower, higher phosphate concentrations were needed to grow the same mass of protoplasm. About two-thirds of the phosphate uptake achieved under constant light conditions is achieved under a di-urnal type light cycle. After shock loading phosphate starved cultures can exhibit phosphate uptakes of up to 20% by weight. (Hancuff-Texas)
W70-06604

STATISTICAL COMPARISON OF TRICKLING FILTER EQUATIONS USING PAPER MILL EFFLUENT DATA,
Johns Hopkins Univ., Baltimore, Md. Dept. of Environmental Engineering Science.
Peter G. Robertson, P. David Wilson, and Jon C. Liebman.
Journal of the Water Pollution Control Federation, Vol 40, No 10, p 1764-1788, Oct 1968. 3 fig, 17 tab, 19 ref.

Descriptors: *Trickling filters, *Mathematical models, *Statistics, Biochemical oxygen demand, Industrial waste, *Waste water treatment.
Identifiers: *Paper mill wastes, Data, Analysis.

The trickling filter design equations of the National Research Council, Rankin, Velz, German, Stack, Schulze, Fairall, and Galler and Gotaas were evaluated for their ability to predict filter performance as calculated from observations taken from various craft and boxboard industry sources. Each observation included such readily measureable variables as BOD influent and effluent concentration, recirculation ratio, hydraulic loading, temperature, filter depth, and media configuration. Regression analysis was used to fit the parameters of these equations to the paper mill data. The residual variations for the fitted models were compared with those of the models using the previously published parameters. The least means square errors (MSE) between the observed and predicted filter performance was provided by the Galler and Gotaas equation. (Hancuff-Texas)
W70-06605

BOD REDUCTION BY CHLORINATION,
Florida Univ., Gainesville. Dept. of Bioenvironmental Engineering.
Russell H. Susag.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R434-R444, Nov 1968. 8 fig, 2 tab, 7 ref.

Descriptors: *Biochemical oxygen demand, *Chlorination, Aerobic treatment, Chemical oxygen demand, Costs, Dissolved oxygen, Waste water treatment, Effluents.
Identifiers: Deoxygenation constant.

The effect of chlorination on deoxygenation behavior was investigated in waste waters and treatment process effluents. Reduction in BOD values was observed on chlorination. What was more significant, however, was the retardation in BOD exertion as demonstrated by a reduction in the deoxygenation constant K. Several tests were conducted employing raw waste water as the test substrate with chlorine dosages varying from 5 to 40 mg/l and chlorine contact time varying from 30 to 60 minutes. At a chlorine dose of 10 mg/l the K value was determined to be 0.143 while the nonchlorinated sample showed 0.195. A comparison between effluent chlorination and additional treatment processes indicated that annual costs for effluent chlorination would be only 8 to 40% of the costs for the additional treatment providing operation periods totalled not more than 52 days annually. The extremely high daily operation costs indicated that the use of this method is limited as a process operation to a non-regular basis. This example indicates that effluent chlorination has a practical application when employed as a supplement to reasonable waste water treatment for the maintenance of desired dissolved oxygen levels at adverse receiving river dilution conditions. (Hancuff-Texas)
W70-06606

THE ROLE OF NITRATE NITROGEN IN BIOOXIDATION,
California Univ., Davis. Dept. of Civil Engineering.
E. D. Schroeder, and A. W. Busch.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R445-R459, Nov 1968. 10 fig, 41 ref.

Descriptors: *Nitrates, *Denitrification, *Aerobic treatment, *Anaerobic treatment, Pilot plant, *Waste water treatment.
Identifiers: *Biooxidation, *Glycolysis, *Krebs cycle, Hydrogen acceptor.

Bacterial reduction of nitrate has been a subject of importance to engineers for many years. An analysis of previous work indicates that little is known of what happens after nitrate is added to a treatment process. It is the purpose of this work to test three environments, aerobic, anaerobic with nitrate, and anaerobic without nitrate--using a bacteria inoculum in a glucose and mineral nutrient system. Results indicate that glycolysis in anaerobic systems using nitrate as a terminal hydrogen acceptor occurred at a faster rate than for other systems, carbon removal rates were lower; and acclamation procedures did not effect the similatory nitrate reduction. A reaction model for the glyclosis-Krebs cycle is set up to describe the three environments. (Hancuff-Texas)
W70-06607

KINETICS OF FIXED FILM BIOLOGICAL REACTORS,
West Virginia Pulp and Paper Co., Covington.
Billie H. Kornegay, and John F. Andrews.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R460-R468, Nov 1968. 3 fig, 1 tab, 7 ref.

Descriptors: *Kinetics, *Trickling filters, *Films, Biological treatment, Pilot plant, Design, Mathematical model, Microorganisms, *Waste water treatment.
Identifiers: *Monod equation, Continuous culture.

A mathematical model based on continuous culture theory has been derived and experimentally varified for microorganisms which grow attached to surfaces. Although the model is not intended to serve as a mathematical approximation of the trickling filter processes, the basic principles illustrated should serve as a foundation in establishing a rational method of design. The continuous function is obtained which describes the rate of substrate removal (glucose used in experiments) from essentially 0 order at high concentrations of substrate to first order at lower concentrations. The completely mixed liquid phase utilized in the experiment was maintained at a pH of 6.5 plus or minus 0.1 and a temperature of 25 plus or minus 0.5 deg C. The dissolved oxygen (DO) concentration varied from approximately 6 to 9 mg/l. The need for a model of this nature is most evident in the design of deep trickling filters. (Hancuff-Texas)
W70-06608

GRAPHICAL ANALYSIS OF BATCH CULTURE DATA USING THE MONOD EXPRESSIONS,
W. E. Gates, and J. T. Marlar.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R469-R476, Nov 1968. 4 fig, 8 ref.

Descriptors: *Kinetics, *Mathematical models, Data collection, Pilot studies, *Waste water treatment, Chemical oxygen demand, Biological oxygen demand.
Identifiers: *Monod equation, *Graphical analysis, Analysis-systems, Continuous culture systems, Plug systems.

The applicability of the Monod equations to the analysis of biological waste water treatment systems has been developed. The extent of its use depends on ease, adequacy, and economics of data collection and analysis. Monod equations relate easily to continuous systems; however, batch systems have been difficult to study in this manner. In an attempt to facilitate the use of Monod equations for batch systems, a graphical method has been developed. Nutrients or organism data may be used; however, both methods require some measure of viable bio-mass (the authors established a correlation between mass concentration and dehydrogenase activity which allows bio-mass calculation). Data show that constants and hydrodynamic properties for batch and continuous systems are transferable. (Hancuff-Texas)
W70-06609

THE EFFECT OF STERILIZATION TECHNIQUES ON WASTE WATER PROPERTIES,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
P. H. Jones, and D. Prasad.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R477-R483, Nov 1968. 2 fig, 2 tab, 29 ref.

Descriptors: *Bacteria, *Effects, *Autoclaves, *Irradiation, Water properties, Physical properties, Chemical properties, Heat and Gamma Rays, Waste water treatment.
Identifiers: *Sterilization.

Two methods of sterilization--autoclaving and radiation--were tested on waste water. The autoclave was operated at conventional temperature and pressure while radiation doses were set at 500,000 to 3,000,000 rads. Pure cultures of Arthrobacter globiformis and Pseudomonas fluorescens were the tested microorganisms. The physical and chemical changes brought about by heat sterilization are significantly greater than those caused by irradiation. From the biological growth studies, the physical changes have a considerable effect on the growth and behavior of certain indigenous waste water bacteria. Thus, for any pure culture or for sterile studies utilizing waste water as a medium more realistic data will be obtained if the waste water is subjected to ionizing radiation rather than autoclaving as a means of sterilizing. (Hancuff-Texas)
W70-06610

A CRITICAL VIEW OF SPECTRO METHODS FOR WATER QUALITY CONTROL,
Department of Water and Power, Los Angeles, Calif.
For primary bibliographic entry see Field 05G.
W70-06611

COMBINED INDUSTRIAL AND DOMESTIC WASTE TREATMENT IN WASTE STABILIZATION LAGOONS,
Federal Water Pollution Control Administration, Grand Forks, N. Dak.
Otmar O. Olson, W. Van Van Heuvelen, and John W. Vennes.
Journal of the Water Pollution Control Federation, Vol 40, No 2, p 214-222, Feb 1968. 2 fig, 8 tab, 8 ref.

Descriptors: *Biochemical oxygen demand, *Efficiencies, *Lagoon, Chemical oxygen demand, Coliforms, Freezing, Photosynthetic bacteria, Stabilization, *Waste water treatment.
Identifiers: *Grafton (N Dak), *Meat processing wastes, *Milk processing wastes, *Potato processing wastes, Suspended solids, Total bacteria.

Stabilization lagoons are used extensively in North Dakota as a means of treating domestic wastes. Developing industries have been discharging their wastes to the local municipalities lagoon and cause problems. Existing design standards recommend an organic loading rate of 20 lbs BOD5/acre/day with provisions for 120 days retention. During the summer months, lagoon efficiency indicated that loadings of 200 lbs BOD5/acre/day could be applied during these periods. The application of potato wastes as well as meat processing and milk wastes to municipal stabilization lagoons can elevate the loading to over 250 lbs BOD5/acre/day resulting in severe nuisance conditions during the spring thaw period. Purple sulfur bacteria develop readily in overloaded lagoons as the temperature is elevated beyond 45 deg F (72 deg C) and anaerobic decomposition of the settled solids promotes the production of hydrogen sulfide (H2S). In-plant treatment of the food processing industry is essential to remove the settleable solids prior to discharge to a lagoon. The suspended solids are a factor in lagoon loading as they tend to drop out during the winter freeze. (Aguirre-Texas)
W70-06612

WASTE WATER TREATMENT FOR THE BURNS HARBOR PLANT OF BETHLEHAM STEEL CORPORATION,
Bethleham Steel Corp., Chesterton, Ind. Burns Harbor Plant.
R. N. Leidner.
Journal of the Water Pollution Control Federation, Vol 41, No 5, Part I, p 796-807, May 1969. 18 fig.

Descriptors: *Activated sludge, *Oil, Skimming, *Waste water treatment, Industrial wastes.
Identifiers: *Steel waste discharge, *Acid waste, Secondary waste treatment, Primary treatment, Coagulant aid, Deep-well injection, Mill wastes, Flocculator-Clarifier, pH.

The Burns Harbor plant of the Bethleham Steel Corporation has a complex waste water treatment facility for all contaminated waste water. The initial design of water and waste water systems included design parameters such as (1) the reuse of process water whenever possible, (2) the segregation of wastes to facilitate treatment, (3) the primary treatment of wastes when required to protect sewer systems, and (4) terminal treatment of all contaminated waste prior to discharge. A study of modifications made to the wastewater systems, in operation since 1964, is also included. pH monitoring, deep-well injection piping materials, and coagulant aids were all changed. The activated sludge unit 0.47 mgd has operated satisfactorily under varied conditions of operation. The Burns Harbor plant is in the process of expanding to an integrated steel mill. (Shankar-Texas)
W70-06614

WATER AND WASTE WATER, WATER POLLUTION CONTROL IN AUSTRALIA,
Metropolitan Water, Sewage and Drainage Board, Sydney (Australia); New South Wales Univ., Kensington (Australia).
For primary bibliographic entry see Field 05G.
W70-06615

SIMPLIFIED MATHEMATICAL PROCEDURE FOR DESIGNING POST AERATION SYSTEMS,
Rex Chainbelt, Inc., Milwaukee, Wis. Process Equipment Div.
For primary bibliographic entry see Field 05G.
W70-06616

INDUSTRIAL WATER MANAGEMENT AT CHRYSLER CORPORATION,
Chrysler Corp., Detroit, Mich. Product Planning and Development.
Alvin R. Balden.
Journal of Water Pollution Control Federation, Vol 41, No 11, Part I, p 1912-1922, Nov. 1969. 11 fig, 3 tab.

Descriptors: *Water management, *Industrial wastes, Oil-wastes, Biochemical oxygen demand, Incineration, Sludge-disposal, Water conservation, *Waste water treatment.
Identifiers: *Air floatation, *Chemical costs, Sedimentation tanks, Drum skimmer.

The paper emphasizes the treatment of oily wastes from industrial waste water. A general review of Chrysler Corporation's experience since the early 1950's is presented. This involves separation of free oil and settleable solids in the primary tanks followed by adsorbtion of oil and particulates on an alum floc and a final polishing of the effluent by sedimentation. Finally incineration is accomplished in the incineration unit by forming a turbulent flame and atomizing the waste materials on to this flame. The disadvantages of this process are also included. Manpower requirements for treatment facilities and chemical costs are reported for the Trenton engine plant. In addition problems experienced with regard to disposal of the oily scum removed from the waste water are reviewed. Potential solutions are discussed. (Shankar-Texas)
W70-06617

RECONSTRUCTION OF OFFERTON SEWAGE WORKS OF HAZEL GROVE AND BRAMHALL UDC,
J. Morton, and F. Summerfield.
Water Pollution Control, Vol 68, No 1, p 85-92, Jan-Feb. 1969. 1 fig, 4 tab, 4 ref.

Descriptors: *Design, *Population, Activated sludge, Automatic control, Disposal, Dissolved oxygen, Costs, *Waste water treatment.
Identifiers: *Sedimentation tank, *Storm tank, *Biological filter, Dry-weather flow, Secondary treatment, Critical path analysis.

The extension of Offerton sewage works to meet treatment requirements in 1980 is discussed. The design is based on a 1980 population of 47,250 persons and a dry-weather flow 2.73 mil gal/d. The design proposals include a new mechanically-raked fine screen, two new storm tanks which will be cleaned by a transferable scraper operating in conjunction with transverse sludge concentrations at the inlet end, and a screw pump for returning the contents of the storm tanks for full treatment. Additional sedimentation capacity will be provided by two 65 ft. dia. and 14 ft. deep tanks. Secondary treatment of sewage will include a simplex surface-aeration plant incorporating six high-intensity cones. Automatic controls for monitoring DO, suspended solids and control of activated sludge return and of sludge blankets in final separating tanks will also be installed. Site investigations were carried out to estimate the cost of extensions. A critical path diagram for pre-constructional events is also presented. (Shankar-Texas)
W70-06618

STABILIZATION OF DAIRY WASTES BY ALGAL-BACTERIAL SYMBIOSIS IN OXIDATION PONDS,
Alexandria Univ. (Egypt). High Inst. of Public Health.
F. M. El-Sharkawi, and S. K. Moawad.
Journal of the Water Pollution Control Federation, Vol 42, No 1, p 115-125, January 1970. 4 fig, 5 tab, 17 ref.

Descriptors: *Dairy industry, *Oxidation lagoons, *Pilot plants, Algae, Biochemical oxygen demand, Biological treatment, Photosynthesis, Stabilization, *Waste water treatment, *Farm wastes.
Identifiers: *Alexandria (Egypt), Pandorina, Soluble organic solids.

A pilot-plant study of BOD reduction of milk processing wastes is reported. A synthetic dairy waste of 750 mg/l BOD was fed continuously to rectangular concrete basins with sloping sides to minimize sludging. The detention period was 10 days. An influent pH of 9.8 was maintained to keep the pH at a level conducive to algal growth. Tank depth was important in maintaining balance between the algal and bacterial fractions of the system. The microflora showed plasticity in adapting to environmental variations. Pandorina constituted a major member of the flora highly adaptable to interaction with dairy wastes. Pandorina could tolerate wide temperature variations (11 deg to 32 deg C) at a constant depth of 75 cm. Other organisms were responsive to specific conditions and when the dominant groups suffered a serious setback, the subdominants flourished. Biochemical oxygen demand (BOD) reductions were 80 to 90 percent at a BOD loading rate of 220 lbs/acre/day (246 kg/dia/day). (Aguirre-Texas)
W70-06619

FIELD EVALUATION OF THE PERFORMANCE OF EXTENDED AERATION PLANTS,
Cincinnati Univ., Ohio. Dept of Environmental Health.
J. David Eye, David P. Eastwood, Fernando Requena, and David P. Spath.
Journal of the Water Pollution Control Federation, Vol 41, No 7, p 1299-1318, July 1969. 20 fig, 19 ref.

Descriptors: *Activated sludge, *Biochemical oxygen demand, *Sewage treatment, *Aeration, Sludge, Nitrogen, Phosphorus, Operations, *Waste water treatment.
Identifiers: *Extended aeration, *Suspended solids, Detention time, Clarifier.

Five extended aeration plants with design flows of 30,500 to 90,000 gpd were studied over a three year period. Variables controlled at various plants included: ratio of actual to design detention times, time of aeration and solids loading. Experimental data included: solids, BOD, COD, nitrogen, phosphates, sludge volume index, pH, temperature, DO and oxygen uptake rates. Studies showed effluent BOD and suspended solids to be closely related. Therefore, the overall performance as measured by effluent quality of the extended aeration plants studied depended mainly on the ability of the system to retain suspended solids and the performance could be enhanced either by enlarging the clarifier or including a sludge wasting step. Considerable reduction in nitrogen was achieved by control of the quantity of air supplied. No net reduction in phosphates was observed. Almost continuous operational control was necessary to insure adequate operation, the most frequently encountered problems being associated with the sludge collecting and return mechanisms. (DiFilippo-Texas)
W70-06620

RESPONSE OF ACTIVATED SLUDGE TO ORGANIC TRANSIENT LOADINGS,
Associated Water and Air Resources Engineers, Inc., Nashville, Tenn.
Carl E. Adams, Jr., and W. Wesley Eckenfelder, Jr.
Journal of the Sanitary Engineering Division, ASCE, Vol 96, No. SA2, p 333-352, April 1970. 20 fig, 7 tab, 7 ref.

Descriptors: *Activated sludge, *Organic loading, *Oxygen requirements, *Kinetics, Domestic wastes, *Industrial wastes, Turbidity, *Domestic wastes, *Waste water treatment.
Identifiers: *Transient loading, Endogenous respiration, Synthetic waste, Settling characteristics.

Three wastes; synthetic, industrial and domestic; were treated in laboratory activated sludge units. The units were subjected to transient organic loadings. Settling characteristics, effluent quality, oxygen requirements, and sludge build-up were

monitored and visual and microscopic evaluation made. Results showed the Kinetic model, q % K sub l s sub e, which expresses removal as a function of growth limiting substrate remaining in solution, to apply satisfactorily to both steady and transient state conditions. The average removal rate coefficient, K sub l, appeared to increase under most transient conditions. This increase was possibly due to changes in organism population. The conventional oxygen utilization model was found to predict the oxygen requirements for steady as well as transient state conditions. The endogenous rate of oxygen uptake increased under transient conditions. The turbidity of the effluent increased with an increase in the average organic loading. Employing the synthetic substrate, it was found that activated sludge systems can tolerate up to three times the normal loading for 12 hours per day for several days without showing any significant increase of effluent soluble organic matter. (DiFilippo-Texas)
W70-06621

EFFECTIVE CHEMICAL TREATMENT FOR INHIBITION OF ANAEROBIC SEWAGE SLUDGE DIGESTION DUE TO ANIONIC DETERGENTS,
Water Pollution Research Lab., Stevenage (England).
J. D. Swanwick, and D. G. Shurben.
Water Pollution Control, Vol 68, No 2, p 190-202, March-April 1969. 7 fig, 5 tab, 9 ref.

Descriptors: *Anaerobic digestion, *Detergents, Laboratory tests, *Sludge treatment, Treatment facilities, Toxicity, Costs, *Waste water treatment.
Identifiers: *Chemical treatment, *Amines.

A report on the use of aliphatic amines and related compounds for the treatment of anaerobic sludge inhibited by increasing amounts of anionic detergents. In initial laboratory experiments Amine HBG and Diamine HPL were used as their acetate salts and added at half the molar equivalent of anionic detergent present in the digesters. A marked response (gas production) to Amine HBG, and a smaller temporary response to Diamine HPL were noted. Fish toxicity tests showed the 48-h median tolerance limit for rainbow trout to be 35-45 mg/l Amine HBG but only 0.4-0.5 mg/l Diamine HPL. Toxicity tests also indicated that in the absence of anionic detergent, Amine HBG was itself toxic to methane bacteria. However, normal operation of a full-scale digester which had failed to produce gas after refilling was accomplished by adding Amine HBG acetate at half the molar equivalent of detergent present. Commercial alternatives to Amine HBG, Armac HT and Amine HBG acetate, and liquid dispersions of Armac HT were also tested, with the liquid dispersions being the most effective. Tests on some 30 other amine materials showed that only one group, ethoxylated amines (Ethomeens) to be more effective than Armac HT. However, the cost of liquid dispersions and the Ethomeens are estimated to be double that of Armac HT or Amine HBG acetate. (Galwardi-Texas)
W70-06622

HYDRAULIC CONTROL UTILIZING SUBMERGED EFFLUENT COLLECTORS,
Brown and Caldwell, Alhambra, Calif.
Theodore V. Lutge.
Journal of the Water Pollution Control Federation, Vol 41, No 8, p 1451-1455, Aug. 1969. 6 fig, 1 ref.

Descriptors: *Design, *Hydraulics, *Waste water treatment, Effluents, Sedimentation, Skimming, Weirs, Water pollution control.
Identifiers: *Effluent collectors, *Submerged collectors, Flow-level control.

Uniform distribution of flow to treatment units, constant water level control, uniform withdrawal of effluent, and where practical the elimination of turbulence may be attained by use of submerged effluent collectors. Where conventional Weirs are used the flow is introduced into sedimentation tanks at high energy levels. Continual weir adjustment, variation in water surface elevations of 4 to 6 inches, settling of tanks, and odors present problems with conventional systems. These shortcomings are overcome by use of the submerged collectors which consist of pipes fitted with orifices. Water levels can be maintained within plus or minus 0.5 inch and without significant orifice head loss, flow through the submerged unit is uniform and is at a lower energy level. A modulating control valve is needed in the outlet channel or pipe to control the water level for efficient skimming. (Berryhill-Texas)
W70-06623

CHARACTERISTICS OF SLUDGE DRYING,
Southern Methodist Univ., Dallas, Tex. Dept. of Civil Engineering.
J. C. Jennett, and I. W. Santry.
Journal of the Sanitary Engineering Division, Proceedings of ASCE, SA5, p 849-863, October 1969. 7 fig, 3 tab, 13 ref.

Descriptors: *Sludge treatment, *Dewatering, Filtration, Sewage treatment, *Waste water treatment.
Identifiers: *Sand beds, Polymers, Activated sludge process, Parameters.

Some parameters involved in the drying process of a digested municipal sludge were listed and evaluated. Model drying beds were built in an existing sludge drying bed of the City of Garland, Texas to take advantage of an operating underdrain system. The bottoms of half of the units were sealed with a plastic liner to simulate an undrained system. Some units were roofed to eliminate rainfall as a variable and some units were constructed with windbreaks to eliminate wind action as a variable. At the end of 28 days on the open beds, the sludge moisture content had decreased an average of 58% on the underdrained beds as opposed to 10% on the identical but non-underdrained beds. The roofed beds had a slower drying rate than the open beds which is in direct conflict with results published elsewhere that indicated that covered beds increase the drying rate by as much as 50%. The results obtained from those beds equipped with windbreaks were inconclusive because the windbreaks, as constructed, were ineffectual in reducing the flow of wind across the sludge surface. The results of an evaluation of open beds with polymer additives indicated that the use of polymers in sludge improved the moisture removal capability of the system considerably. Little increase in moisture removal was noticed in the sludge dosed with 200 ppm of the various polymers over that sludge containing only 50 ppm of the various polymers. (Galwardi-Texas)
W70-06624

THE ACIDIFICATION OF A RAW SEWAGE SLUDGE,
Water Pollution Control Works, Halifax (Nova Scotia).
J. Hatfield.
Water Pollution Control, Vol 68, No 6, p 673-678, Nov-Dec 1969. 5 fig, 6 tab, 6 ref.

Descriptors: *Sludge treatment, *Sewage sludge, *Filtration, Textiles, Dissolved solids, *Waste water treatment.
Identifiers: *Dilution, *Acidification, *Elutriation, *Specific resistance, Infra-red spectra grease, Capillary suction, Precipitation.

The effect of acidification on the dewatering characteristics of a sewage sludge was analyzed. The sludge used throughout the experimental work was obtained from sewage containing mainly textile wastes. The addition of sulphuric acid precipitates finely-divided suspended matter and with very greasy sewages precipitation of soaps to their insoluble fatty acids occurs. Infra-red absorption spectra of the obtained grease and its two main fractions (fatty acids and unsaponifiables) were presented. The specific resistance determined by the capillary suction method was used for comparing filtrabilities. The addition of sulphuric acid greatly improved the filtrability of this particular sludge with the maximum occurring at pH3. However, this improvement is relatively small compared with the improvement in filtrability obtained by the use of conventional conditioning agents. A minimum value for specific resistance of 0.3 x 10 to the 9th power (sq s)/g was obtained. A 50 percent increase in dissolved solids in the filtrate occurred upon acidification to pH3. It was also noted, that as the pH increases, the specific resistance increased sharply. No change occurred in the pH or filtrability of acidified samples which were allowed to stand overnight and for several days. Increases in filtrability were noted in samples of sludge on which dilution, acidification and elutriation had been performed. The elutriated sludge filtrability increases the least on dilution, and no appreciable loss of suspended solids was noted upon elutriation. This improved filtrability may be due to the removal of electrolytes. (Galwardi-Texas)
W70-06625

OPERATOR TRAINING BY AN IN-PLANT APPRENTICESHIP PROGRAM,
Orange County Sanitation Districts, Fountain Valley, Calif.
Fred A. Harper.
Journal of the Water Pollution Control Federation, Vol 41, No 12, p 2010-2017, Dec 1969.

Descriptors: *Training, *Operations, *Education, *Waste water treatment, Schools (Education).
Identifiers: *Orange County (Calif), *In-Plant Training, *Operator.

The Orange County Sanitation Districts (California) have developed a two phase in-plant operator training program. The waste water quality control system serves a population of 1.25 million and projections indicate 2.5 million by year 2000. With objectives to train personnel for maximum benefits to the Districts, the individual, the community, and industry, the program was initiated in July, 1967. Educational requirements and program outlines are given for Apprentice I and Apprentice II. The Apprentice I program must be completed before entering the Apprentice II program. Participants are trained in all levels of operation of units and in routine laboratory work. Records and report writing are stressed throughout the program. A side benefit is gained from existing personnel preparing and applying training methods and techniques. (Berryhill-Texas)
W70-06626

THE ACTIVATED-SLUDGE PROCESS AS A HIGH-RATE SEWAGE-TREATMENT SYSTEM,
Simmon-Carves Ltd., Stockport (England).
J. W. Abson, and E. I. Clark.
Water Pollution Control, Vol 68, No 5, p 574-583, 1969. 4 fig, 3 tab, 8 ref.

Descriptors: *Waste water treatment, *Activated sludge, *Biochemical oxygen demand, *Dissolved oxygen, Pilot plants, Nitrification, Ammonia, Effluents, Design, Aeration.
Identifiers: *Suspended solids, *Sludge volume index (SVI), Phosphate removal, Respirometer.

It has been shown that with simple substrates and mixed cultures the oxidation rate was not dependent on the substrate concentration. Four pilot studies on domestic sewage demonstrated that the 30:20 standard could be met using the described high-rate activated sludge process. A range of BOD loadings between 0.22 and 0.69 lb/lb MLSS-day produced no difficulties in sludge settling. This was attributed to high concentrations of DO in the mixed liquor entering the settling tank and the satisfaction of the BOD. Substantial amounts of ammonia were removed with significant reduction in the settling tank. This was attributed to high activated sludge concentration and high DO level (8mg/l) of the effluent entering the settling tank. Analysis showed that 70-75 percent of the incom-

ing phosphate was removed at Works III plant. In systems with high MLSS Sludge Volume Index values in excess of 100 did not present problems if an adequate DO level was maintained. In operation of compact systems hydraulic loading was maintained within defined limits. The system described incorporates the efficiency of the lower-rate process and the cost savings of the high-rate system. (Berryhill-Texas)
W70-06627

QUANTITATIVE METHODS FOR THE CONCENTRATION OF VIRUSES IN WASTE WATER,
Arizona Univ., Tucson. Dept. of Microbiology.
Marion L. Moore, Peter P. Ludovici, and Wayburn S. Jester.
Journal of the Water Pollution Control Federation, Vol 42, Research Supplement, p R21-R28, February 1970. 6 fig, 8 ref.

Descriptors: *Adsorption, *Membrane, *Viruses, Waste water treatment.
Identifiers: *Poliovirus type 1, *Viral monitoring, Enterovirus, Filtration, Aluminum hydroxide, Dowex Resin Column, Protamin Sulfate.

The effectiveness of viral concentration procedures for a viral monitoring procedure was investigated. Samples seeded with poliovirus showed a recovery rate ranging from 0.6 to 5.0 percent when using a membrane concentration procedure. Eighty-nine percent of the loss occurred during the preconcentration steps when the water was clarified and freed of bacteria by passage through AP 20 prefilters and GS 0.22 micro membranes. Serum pretreatment of the AP 20 pads for removal of debris and use of untreated Gelman GA-8, 0.20 micro membranes for removal of organisms was found to be the most effective preconcentration procedure. Two membrane adsorption procedures, using protamine sulfate and anion exchange resin, for concentrating virus were compared with an aluminum hydroxide virus adsorption technique. The most effective procedure was the Al (OH) sub 3 method yielding 81 to 100 percent virus recovery as compared to only 23 to 38 percent for membrane adsorption techniques. (Bishop-Texas)
W70-06628

THE USE OF TETRAZOLIUM SALTS AS A MEASURE OF SLUDGE ACTIVITY,
Toronto Univ. (Ontario). Dept. of Civil Engineering.
Philip H. Jones, and Durga Prasad.
Journal of the Water Pollution Control Federation, Vol 41, No 11, Part 2, p R441-R449, November 1969. 98 fig, 1 tab, 23 ref.

Descriptors: *Reduction, Sludge, Aeration, *Waste water treatment, Irradiation.
Identifiers: *Metabolic activity, *Dehydrogenase, *Chloride, Oxygen uptake, Triphenyltetrazolium, Reduction, pH, Triphenylformazon.

The rate of oxygen uptake is one method of establishing the activity of organisms. For each molecule of oxygen used two hydrogen atoms are released. Thus the rate of release of hydrogen atoms would be an equally accurate measure of metabolic activity of a completely aerobic system. One method which measures this dehydrogenase activity makes use of triphenlytetrazolium chloride (TTC) a colorless substance which upon reduction goes to triphenylformazon (TPF) a red-colored substance. The effects of aeration, pH, photochemical reduction and gamma irradiation on dehydrogenase activity were studied. Comparisons were made between oxygen uptake and TPF production. It was found that oxygen is a competitive inhibitor in the TTC-TPF reaction, that the production of TPF reaches a peak and fades off with time, that the effect of pH is extremely noticeable, that a high degree of photochemical activity is observed at high pH values, that gamma-irradiated waste water maintains some residual dehydrogenase activity and that dehydrogenase activity may be correlated with oxygen uptake. The results show that TTC at best can be considered as a gross measurement of activity. (DiFilippo-Texas)
W70-06629

BACTERIOLOGY OF AN ACTIVATED SLUDGE WASTE WATER TREATMENT PLANT - A GUIDE TO METHODOLOGY,
Western Washington State Coll., Bellingham.
Bruce Lighthart, and R. T. Oglesby.
Journal of Water Pollution Control Federation, Vol 41, No 8, Part II, p R267-R281, Aug. 1969. 6 fig, 6 tab, 33 ref.

Descriptors: *Methodology, *Activated sludge, *Waste water treatment, Isolation, Biomass, Costs, Ecosystem, Biochemical Oxygen Demand.
Identifiers: *Bacteriology, Isolet test battery, Cluster analysis.

A methodology whereby data to construct a factual and detailed description of the bacterial ecosystem is presented. Using a miniaturized and mass inoculation procedure, a battery of tests to measure physiological, biochemical and morphological characterizing features of a large number of waste water isolates have been developed. The tests indicate that there are several diffuse groups of organisms in the raw waste water and at least three clusters in settled biomass and aerator effluent. The latter three clusters have properties similar to Pseudomonds and Achromobacter and Flavobacteriacytophaga genera, respectively. The techniques presented are relatively simple and are low in both monetary and temporal costs and provide information needed for ecosystem analysis for improved new designs and biological treatment facilities. (Shankar-Texas)
W70-06630

RECENT PROGRESS IN THE BLACKBURN MEADOWS RECONSTRUCTION AND EXTENSION SCHEME AT SHEFFIELD,
Sheffield Sewage Disposal Dept. (England).
A. Holroyd.
Water Pollution Control, Vol 68, No 3, p 357-367, May-June, 1969. 5 fig, 3 ref.

Descriptors: *Flow control, *Disposal, *Costs, *Waste water treatment.
Identifiers: *Settling tank, *Sludge incineration, Sludge scraper, Sludge withdrawal, Photoelectric probe, Furnace, Screening.

Certain phases of the Blackburn Meadows reconstruction and extension scheme are discussed. Emphasis is placed on phases relating to settling tanks and sludge incineration plant both of which are nearing completion. Eight new rectangular settlement tanks have been constructed each 234 feet by 75 feet, 11 feet depth at inlet and 10 feet at outlet. Each tank is provided with a 'buoyant flight' sludge scraper. Flow control is accomplished by a semi-automatic system. In addition a system of sludge withdrawal has been designed for equal sludge outputs from each of the tanks. Control of sludge blanket surface to any predetermined level is maintained using a photo-electric probe. The final disposal of the sludge by incineration is discussed. The Nicholas-Herreshoff multiple hearth furnace is recommended for incineration. Details of the feeder system, control room, furnaces, shaft cooling and scrubber system are dealt with and estimates of costs of the installation are presented. (Shankar-Texas)
W70-06631

AERATION IN WASTE WATER TREATMENT - MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washington, D.C. Technical Practice Committee.

Miles A. Lamb (Chairman) and W. E. Dobbins (Vice Chairman) of the Subcommittee. Journal of the Water Pollution Control Federation, Vol 41, No 11, p 1863-1878, Nov 1969. 9 fig, 3 tab.

Descriptors: *Waste water treatment, *Aeration, *Diffusion, *Oxygen requirements, *Maintenance, *Diffusivity, *Oxygen, *Operation and maintenance, Oxygenation, Oxidation lagoons.
Identifiers: Aerators, Air diffusers, Diffusers, Mechanical aerators, Oxygen uptake rate.

'Aeration in Waste Water Treatment' is the revised edition of the original Manual of Practice No. 5 entitled 'Air Diffusion in the Sewage Works', published in 1952. The manual provides designers, operators, and maintenance personnel of waste water treatment facilities with the basic theory and operational aspects of aeration. This first installment of a three part serialization covers the first two chapters of the manual. Subjects covered include a brief history of aeration, brief summaries of aeration processes in waste water treatment, and air introduction devices. Subjects covered in the second chapter generally deal with determination of oxygen requirements. Specifically, it covers air requirements for waste water treatment, oxygen uptake rates, rates of solution of oxygen, full-scale testing, and mixing requirements. (Makela-Texas)
W70-06632

AERATION IN WASTE WATER TREATMENT - MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washington, D.C. Technical Practice Committee.

Miles A. Lamb (Chairman) and W. E. Dobbins (Vice Chairman) of the Subcommittee. Journal of the Water Pollution Control Federation, Vol 41, No 12, p 2026-2061, Dec 1969. 28 fig, 1 tab.

Descriptors: *Waste water treatment, *Aeration, *Diffusion, *Oxygen requirements, *Maintenance, *Diffusivity, *Oxygen, *Operation and maintenance, Oxygenation, Oxidation, Lagoons.
Identifiers: Aerators, Air diffusers, Mechanical aerators, Oxygen uptake rate, Manual of operation oxygenation capacity.

'Aeration in Waste Water Treatment' is the revised addition of the original Manual of Practice No. 5 entitled 'Air Diffusion in the Sewage Works', pbulished in 1952. The manual provides designers, operators, and maintenance personnel of waste water treatment facilities with the basic theory and operational aspects of aeration. This is the second installment of a three part serialization and covers the third and fourth chapters of the manual. Chapter 3 covers types and applications of diffusers. Specific subjects include diffuser location, mounting and number, oxygenation capacity, calculation of air requirements, air distribution, economics, flexibility, porous diffusers, non-porous diffusers, and European practice. Chapter 4 covers the types and applications of mechanical aerators. Specific subjects include plate types, brush types, European practice, and aerated lagoons. (Makela-Texas)
W70-06633

COOLING TOWERS AND WEATHER, REPORT TO FEDERAL WATER POLLUTION CONTROL ADMINISTRATION,
Oregon State Univ., Corvallis. Dept. of Physics.
F. W. Decker.
Typescript 26 p, February 1969. 2 fig, 17 ref.

Descriptors: *Cooling towers, *Weather, *Fog, *Precipitation, Humidity, Mixing, Temperature, Evaporation.
Identifiers: *Site selection, Esthetic effects, Drizzle intensities, Plumes, Eliminators.

Possible nuisances created by heated air and water vapor raised questions of fog, precipitation and esthetic effects on neighboring property usage. These effects will be minimum if the drizzle falls into a relatively deep layer of air and thereby evaporates with great dilution by air. Thus the natural-draft tower has an advantage over the forced-draft tower because of the greater height of the efflux from the former. Objective determination of fog-forming capabilities as a result of

suspected drizzle from cooling tower plumes will require field information about the actual drizzle intensities and effectiveness of such drizzle in producing surface fog. Empirical probabilities of high humidity and light air movement in combination with surface air cooling represents the chief source of information obtained from the estimate of the frequency of occurrence of fog nuisance created by the cooling tower. 'Eliminators' which intercept the upward carried driplet in the region above the packing and the windbreak or screening to prevent strong winds blowing directly across the bottom of the cooling tower, are the modern solutions of the problem. Other solutions are site selection to assure an adequate area around the tower in which any precipitation may fall without nuisance and site selection to eliminate possible nuisance of the cooling tower for nearby activities. European experience and calculations for American conditions showed low probability of fog while uncertainties concerning precipitation may need resolution to determine certain marginal probabilities of drizzle-caused fog. (Upadhyaya-Vanderbilt)
W70-06639

THERMAL POLLUTION AND THE WATER COOLING TOWER,
Marley Co., Kansas City, Mo.
J. B. Dickey, Jr., and R. E. Cates.
Marley Co., Kansas City, Mo, 1970. 14 p, 8 fig.

Descriptors: *Thermal pollution, *Cooling towers, Cooling, Heat balance, Ventilation, Condensation, Water cooling, Thermal powerplants, Electric power industry, Steam, Thermal power, Evaporation, Temperature, Air temperature, Saturation.

One solution to thermal pollution by the electric utility industry lies in the use of water cooling towers. Various operating needs include small unit municipals through syndicates operating multiple units aggregating over 5000 mega watts. Operating conditions include constant on-line recirculating, stand-by or 'trim' duty, and once-through systems to limit terminal differences. Types of towers are discussed as larger induced draft, forced and assisted draft, natural draft, and the DriTower. Geographical aspects of design and operating problems are outlined. Accompanying the discussion is a presentation of evaluation factors including methods of selection and optimization of both Mechanical and Natural Draft Cooling Towers. (Novotny-Vanderbilt)
W70-06640

BIOLOGICAL RECOVERY OF WASTE WATER,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
K. L. Schulze.
Journal Water Pollution Control Federation, Vol 38, No 12, p 1944-1958, 1966. 2 fig, 4 tab, 15 ref.

Descriptors: *Waste water (Pollution), *Biological treatment, Tertiary treatment, Michigan, Biochemical oxygen demand, Turbidity, Suspended load, Coliforms, Aquatic plants, Fish, Dissolved solids, Chemical oxygen demand, Nitrates, Phosphates, Conductivity, Hydrogen ion concentration, Temperature, Dissolved oxygen, Biological communities, Sphaerotilus, Beggiatoa, Diatoms, Cyanophyta, Chlorophyta, Rotifers, Annelids, Crustaceans, Copepods, Snails, Turtles, Chlorella, Euglena, Scenedesmus, Chlamydomonas.
Identifiers: East Lansing (Mich), Lebistes, Vallisneria, Potamogeton, Elodea, Ceratophyllum, Lemna, Myriophyllum, Zoogloea, Nitzschia, Navicula, Oscillatoria, Rhizoclonium, Paramaecium, Stentor, Epistylis, Tubifex, Acolosoma, Cladocera, Ostracoda, Physa, Helisoma, Graptemys.

In attempting to develop biological treatment methods for complete recovery of waste water, a model tertiary biological waste treatment process was operated using final effluent from the East Lansing, Michigan, sewage treatment plant (activated sludge) as raw material. The model was operated under continuous-flow conditions and at retention times varying from 10 to 36 hours. At about 24-hour retention time, removals on the order of 90% for biochemical oxygen demand, 92% for turbidity, 94.5% for suspended solids, and 96% for coliform bacteria were obtained. These removals correspond to overall reduction values of 98 to 99% for the combined secondary and tertiary treatment processes. Preliminary data indicated that reduction in phosphorus through the tertiary unit was on the order of 20 to 30%. The effluent from the tertiary unit was discharged through a 10-gallon aquarium stocked with water plants and a pair of guppies. The plants produced luxuriant growth and the fish went through their reproductive cycle with no extraneous food supply. Similar results were obtained with a set of 200-gallon tanks where young minnows, dace, lake chub, green sunfish, black crappies, and large-mouth bass were used as test fish. (Jones-Wisconsin)
W70-06671

THE WASTE TREATMENT MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06687

SYNTHESIS OF THE DISPERSION AND WASTE TREATMENT MODELS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06688

REDUCTION OF RIVER HEAT POLLUTION BY TURBULENCE STIMULATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
Victor E. Scottron.
Completion Report, March, 1970. 3 p. OWRR Project A-011-CONN.

Descriptors: *Thermal pollution, Turbulence, Diffusion.

The results of two experiments are report: (a) A wind tunnel study was made of a two-dimensional natural river bed model containing sand waves. Data were taken regarding mean velocity distribution angle of flow, static pressure distribution and longitudinal turbulence intensity along a typical wave. While valuable conclusions were obtained concerning the mechanism of bed-load transport, natural bottom roughness did not appear to assist in preventing thermal stratification. (b) A wind tunnel study was made of a two-dimensional heat-stratified flow. A mathematical model was developed and compared with measured temperature profiles for flow over both smooth and rough boundaries. Increased turbulence levels greatly accelerated the mixing rates.
W70-06704

5E. Ultimate Disposal of Wastes

LEGAL ASPECTS OF LAKE DIVERSION (DIVERSION FROM LAKE MICHIGAN, AND DISPOSAL OF SEWAGE INTO THE MISSISSIPPI WATERSHED, BY CHICAGO),
For primary bibliographic entry see Field 06E.
W70-06477

SELECTION OF REFUSE DISPOSAL SITES IN NORTHEASTERN ILLINOIS,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 05B.
W70-06572

BIOLOGICAL ASPECTS OF ORGANIC WASTE TREATMENT,
Bath Univ. of Technology (England).
For primary bibliographic entry see Field 05D.
W70-06588

A REVIEW OF POULTRY WASTE DISPOSAL POSSIBILITIES,
Ministry of Agriculture, Fisheries and Food, London (England).
C. T. Riley.
Water Pollution Control, Vol 67, No 6, p 627-631, 1968. 5 tab, 4 ref.

Descriptors: *Waste disposal, *Waste treatment, *Biochemical oxygen demand, *Costs, Waste identification, Drying, Land use, Aeration, Loading, Odor.
Identifiers: *Poultry waste disposal, *Bod/food intake relation, *Waste storage, *Chemical and physical properties (Waste), Heat drying, Nitrogen, Phosphorus, Potassium, Pasveer ditch, Bubble-gun installation, Processing stations (Poultry), Deep litter and broiler houses, Inedible by-products, Shock load.

Waste disposal problems in the poultry industry, contemporary poultry practice and related developments in agriculture are discussed, and trends considered. The main types of waste are analyzed; wastes from laying hens has higher NPK values than any other agricultural waste. A National Agricultural Advisory service (NAAS) survey emphasized the lack of knowledge, high cost of waste disposal to egg producers and social effects of the current tendency to increase livestock numbers and (due to transportation costs) to group production units near centers of consumption. Analysis is made of waste quantities and the chemical and physical properties of the waste. A reliable correlation appears to exist in BOD/food intake relationship. Settling difficulties in treatment are noted. The relationships between disposal practices and land uses are examined. The major problems arising from traditional methods of disposal are analyzed, especially the storage and heat drying phases. Traditional methods of sewage treatment no longer appear suitable for poultry wastes. The 'Pasveer ditch' or 'bubble-gun' type of installation may be more suitable; however, the high concentration of waste remains a problem. The treatment and disposal of wastes from deep litter and broiler houses is troublesome mainly if local accumulations become too large. This type of waste has the highest nitrogen content of all agricultural wastes. (D'Arezzo-Texas)
W70-06590

FARM WASTE DISPOSAL IN RELATION TO CATTLE,
National Agricultural Advisory Service, London (England).
J. Gibbons.
Water Pollution Control, Vol 67, No 6, 1968. p 622-626, 2 tab, 4 ref.

Descriptors: *Disposal (Wastes), *Waste treatment, *Cattle, *Livestock, *Farm wastes, Costs, Silage, Effluent, Economic impact, Digestion, Drains, Groundwater, Streams, Buildings, Construction.
Identifiers: *Farm waste disposal, *Farm waste production, *Cow cubicles, *Dry-land farm, *Silage effluent, *Wet farms, Population equivalents of farm waste, Farming patterns, Solid systems, Organic irrigation, Slurry handling, Cubicle-housing/law labour system, Storage.

Changes in the pattern of farming and consequent effects on the nature of manure disposal problem on farms are discussed. Modern systems of dairy farming, including the special impacts of widespread production of silage, and the growth of the cubicle system of housing are examined. The consequent effluent disposal problems are evaluated. Design of disposal systems must take into account: animal waste quantity estimates and the

population equivalents of these farm wastes. Also, a vital factor in design requirements is evaluation of the changing patterns of farming. Waste treatment and disposal are discussed from the viewpoints of solid systems, handling organic irrigation methods, and slurry handling methods. The factors affecting storage requirements and capacities are analyzed. An important consideration in most systems is to keep the volume of contaminated liquid to a minimum and this is a vital factor in building design. Silage effluent treatment is given special attention because of the serious pollution problem which it can create. Special efforts are required to keep silage effluent from entering drains, streams, or groundwaters. Proper system design must consider land use, the type of existing facilities, the scale of enterprise, and type of livestock. Economic and technical considerations jointly should underlie the final design decisions. (D'Arezzo-Texas)
W70-06591

SLUDGE TREATMENT AND DISPOSAL AT THE BROCKHURST WORKS OF THE UPPER TAME MAIN DRAINAGE AUTHORITY,
Upper Tame Main Drainage Authority, Birmingham (England).
For primary bibliographic entry see Field 05D.
W70-06594

REFUSE DISPOSAL IN DUTCHESS COUNTY, NEW YORK.
New York State Office of Planning Coordination, Albany.

Prepared in cooperation with Dutchess COUNTY Dept. of Planning, Poughkeepsie, N. Y. Available from the Clearinghouse as PB-188 786, $3.00 in paper copy, $0.65 in microfiche. Report Aug, 1969. 75 p, 8 tab, 3 append. HUD Project UPAP NYP-87 (New York)

Descriptors: *Industrial wastes, *Waste disposal, Sanitary engineering, Municipal wastes, *Sanitary engineering, Sewage, Rural areas, Incineration, City planning, Domestic wastes.
Identifiers: Regional planning and development, *Dutches County (N Y), *Refuse disposal, *Sanitary landfills, Solid waste disposal, *Refuse composing.

This study reviews existing local refuse disposal problems, available refuse disposal methods and administrative structures and overall implications of refuse disposal as it relates to Dutchess County. Review of existing refuse disposal service shows potentially serious problems both in the urban core area and rural communities in complying with the provisions of Part 19 of the State Sanitary Code affecting refuse disposal. Evaluation of the problem on a broad basis indicates economies can be achieved through the creation and operation of a county-wide refuse disposal district and a system of transfer stations. The study further recommends that the County apply for a N.Y.S. Solid wastes Planning grant to further develop and implement this proposal.
W70-06711

5F. Water Treatment and Quality Alteration

INSTALLATIONS FOR OZONIZING WATER (EXCERPTS),
Foreign Technology Div. Wright-Patterson AFB, Ohio.
V. F. Kozhinov.
Trans. of mono. Ustanovki dlya Ozonirovaniya Vody, Izd-vo Literatury po Stroitel'stvu, Moscow, 1968, p. 9-21, 167-169, by D. Koolbeck. Available from the Clearinghouse as AD-700 476, $3.00 in paper copy, $0.65 in microfiche. Rept. No. FTD-HT-23-315-69, Oct. 15, 1969. 21 p, 9 fig, 47 ref.

Descriptors: *Ozone, *Oxidation, *Chemical reactions, Molecular structure, Solubility, Oil, Coals, *Water treatment.
Identifiers: USSR.

A brief statement of the history of the discovery of ozone and the determination of its physical constants is given. The molecular structures of the gas are outlined, and some details regarding the decomposition of ozone in air, distilled water, and various natural waters in Switzerland are presented. The solubility of ozone in water is examined and the coefficient of ozone distribution in a water/air system is determined. Reactions of ozone with inorganic materials are touched upon briefly, and a somewhat longer discussion of ozone reactions with organic substances, mainly wastes of coke and petroleum chemistry processes, is given.
W70-06453

5G. Water Quality Control

PRELIMINARY OPERATIONS PLANNING MANUAL FOR THE RESTORATION OF OIL-CONTAMINATED BEACHES.
URS Research Co., San Mateo, Calif.

Available from the Clearinghouse as PB-191 711, $3.00 in paper copy, $0.65 in microfiche. Federal Water Pollution Control Administration Research Series Report 15080 EOS 3/70, February 1970. 53 p, 15 fig, 21 tab. FWPCA Project 15080 EOS--3/70, Contract 14-12-811.

Descriptors: *Oily water, *Beaches, *Water pollution control, *Soil contamination, *Pollution abatement, Cleaning, Oil wastes.
Identifiers: *Beach restoration (Oily sand).

An Operations Planning Manual was prepared for use by FWPCA personnel involved in oil-spill cleanup operations. The surface conditions and topography of a beach contaminated with oil and the manner in which the oil has been deposited onto the beach will dictate the choice of equipment to be utilized and the operating procedures to be followed. The procedures tested utilize motorized graders, motorized elevating scrapers, front end loaders, and conveyor-screening systems. A motorized grader and motorized elevating scraper working in combination provide the most rapid means of beach restoration; and in addition, their use results in the removal of the smallest amount of uncontaminated beach material. (Knapp-USGS)
W70-06319

REVIEW OF THE SANTA BARBARA CHANNEL OIL POLLUTION INCIDENT,
Battelle Memorial Inst., Richland, Wash. Pacific Northwest Labs.
For primary bibliographic entry see Field 05B.
W70-06320

SUMMARY OF WATER QUALITY STANDARDS FOR THE INLAND AND COASTAL WATERS OF TEXAS.
Federal Water Pollution Control Administration, Austin, Tex., and Texas Water Quality Board, Austin.

Federal Water Pollution Control Administration -- Texas Water Quality Board, Cooperative Report, September 1969. 43 p, 2 fig, 4 tab.

Descriptors: *Water quality act, *Water quality, *Standards, *Texas, Legislation, Water pollution, Water pollution control, Sewage treatment, Interstate, Water utilization.
Identifiers: *Texas water quality standards.

Texas adopted standards for its interstate and intrastate waters on June 26, 1967, which were then submitted to the Department of the Interior. Subsequently on October 5, 1967, revisions were made by Texas in their original standards, and the Secretary of the Interior approved the standards, as revised on January 27, 1968. At the request of the Secretary of the Interior, Texas adopted a policy to protect its high quality interstate waters, which was approved on May 2, 1969. The standards consist of three major components: designation of the uses which the waters are to serve, specification of narrative and numerical criteria to protect and enhance water quality, and specification of a plan of implementation and enforcement, which includes treatment and control requirements for municipal, industrial and other waste discharged to or affecting Texas waters. (Knapp-USGS)
W70-06357

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,
American Society of Civil Engineers, New York.
L. S. Tucker.
Available from the Clearinghouse as PB-191 714, $3.00 in paper copy, $0.65 in microfiche. ASCE Technical Memorandum No 6, Combined Sewer Separation Project, November 15, 1967. 35 p, 14 fig, 1 tab, 12 ref. FWPCA Project 11020 EKO--11/67, Contract 14-12-29.

Descriptors: *Sewers, *Storm drains, *Pressure conduits, Cities, Hydraulics, Pipes, Closed conduit flow, Waste disposal, Drainage systems, Engineering structures, Hydraulic transportation.
Identifiers: Combined sewage, High pressure sewers.

A general concept is proposed for separation of combined sewerage systems which involves discharging comminuted sewage from individual buildings or building complexes through relatively small pressure tubing. The tubing would connect to new transmission conduits located outside the buildings. The new separate sanitary sewage street pressure condiuits would then discharge into existing interceptors that would convey the sanitary sewage to treatment works. Storm water alone would be carried in what were formerly combined sewers. (Knapp-USGS)
W70-06406

FEDERAL AID TO THE STATES: AN ANALYTICAL EXAMINATION OF THE ALTERNATIVES,
Washington Univ., St. Louis, Mo.
Murray L. Weidenbaum.
The American Journal of Economics and Sociology Vol 28, No 4, p 367-383, October 1969. 17 p.

Descriptors: *Taxes, *Resource allocation, *Federal government, *State government, *Local government, *Economic evaluation, Government supports, Income, Human resources, Decision making, Investment, Costs, Revenue, Gross National Product, Tax rates.
Identifiers: *Tax sharing, *Tax credits, *Program grants, *Block grants, Economic stability, Tax base, Income redistribution.

Due to the intrastate nature of many water pollution problems Federal assistance in their solution has received considerable attention and this study of the economic problems involved is informative with respect to understanding the effects of federal aid to the States. The purpose of the article is to contribute to finding an optimal program for Federal assistance by arraying and objectively comparing the various alternative approaches. It examines the case for increased federal financial assistance to state governments and their subdivisions and analyzes the major alternative ways of distributing the aid. The alternatives examined are shared revenues, tax credits, direct federal operations, program grants, straight block grants, and block grants with an equalization feature. The criteria for evaluation are income distribution, resource allocation and stabilization. The study indicates that block grants with an equalization feature yield the greatest amount of income redistribution but that tax credits and tax sharing might tend to result in larger expenditures for selected areas, based on the recent allocation patterns of state budgets. (Murphy-Rutgers)
W70-06410

PERNELL V CITY OF HENDERSON (ACTION AGAINST MUNICIPALITY FOR THE UNREASONABLE DIVERSION OF WATER TO THE HARM OF RIPARIAN OWNERS).
For primary bibliographic entry see Field 04A.
W70-06474

ATMOSPHERIC EMISSIONS FROM WET-PHOSPHORIC ACID MANUFACTURE,
National Air Pollution Control Administration, Raleigh, N.C.; and American Cyanamid Co., Wayne, N.J.
For primary bibliographic entry see Field 05B.
W70-06521

MINE WATER RESEARCH: PLANT DESIGN AND COST ESTIMATES FOR LIMESTONE TREATMENT,
Bureau of Mines, Pittsburgh, Pa. Coal Mining Research Center.
For primary bibliographic entry see Field 05D.
W70-06532

POSSIBILITIES OF BIOLOGICAL CONTROL OF AQUATIC WEEDS IN INDIA.
Commonwealth Inst. of Biological Control, Bangalore (India).
For primary bibliographic entry see Field 04A.
W70-06549

COMMUNITY ACTION GUIDEBOOK FOR SOIL EROSION AND SEDIMENT CONTROL,
National Association of Counties Research Foundation, Washington, D.C.
Mel D. Powell, William C. Winter, and William P. Bodwitch.
Available from the Clearinghouse as PB-191 765, $3.00 in paper copy, $0.65 in microfiche. National Association of Counties Research Foundation Publication, p G1-G64, 1970. 64 p. FWPCA Grant No 15030 DTL--3/70.

Descriptors: *Soil erosion, *Sediment control, *Road construction, *Urbanization, Legislation, Water law, Soil conservation, Social aspects, Legal aspects, Governments.
Identifiers: Urban Sediment control.

Erosion and sediment, once thought of as rural problems, are causing extensive damage to the soil and water resources of developing communities. Sediment caused by careless development and construction has become one of the Nation's most serious sources of water pollution. This guidebook is intended to help local officials to organize, plan, finance, staff, and implement comprehensive sedimentation control programs. In addition it should help local officials and administrators understand what is basically a technical problem; it will also help soil and water experts and technicians understand the administrative aspects of sedimentation control. This mutual understanding is necessary if effective control is to be achieved. The concepts and principles presented are based on a year of research, including visits to federal and state agencies and 14 visits to local sedimentation control programs across the United States. A model approach, with appropriate modifications, may be used by many local governments to control their sedimentation problems (Knapp-USGS)
W70-06574

THE CONTROL AND TREATMENT OF TRADE EFFLUENTS,
Greater London Council, London (England).
For primary bibliographic entry see Field 05D.
W70-06589

TECHNOLOGIES IN COAGULATION,
Bissell, Bronkie and Associates, Williamsville, N.Y.
For primary bibliographic entry see Field 05D.
W70-06593

OXYGEN DEMAND AND SUPPLY IN AN ACTIVATED SLUDGE PLANT,
Michigan State Univ., East Lansing. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06598

OVERLOADED OXIDATION PONDS--TWO CASE STUDIES,
Kansas Univ., Lawrence. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06601

REGIONAL MANAGEMENT OF WATER QUALITY--A SYSTEMS APPROACH,
Louisiana State Univ., Baton Rouge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 05D.
W70-06602

A CRITICAL VIEW OF SPECTRO METHODS FOR WATER QUALITY CONTROL,
Department of Water and Power, Los Angeles, Calif.
George A. Uman.
Journal of the Water Pollution Control Federation, Vol 40, No 11, Part 2, p R484-R488, Nov 1968. 2 fig, 8 ref.

Descriptors: *Spectroscopy, *Standards, *Statistics.
Identifiers: *Criticism, *Accuracy, *Procedures.

The statisticians influence on the spectrocopist from the standpoint of improving the accuracy of his analysis is criticized. The problems of sample selection, water quality criteria, analytical methods, and accuracy of results were discussed with this thought in mind, 'is there enough information known about standards, controlling parameters, and methods for meaningful results'. The shortcomings of the statistical approach are highlighted. (Hancuff-Texas)
W70-06611

WATER AND WASTE WATER, WATER POLLUTION CONTROL IN AUSTRALIA,
Metropolitan Water, Sewage and Drainage Board, Sydney (Australia); New South Wales Univ., Kensington (Australia).
K. B. Thistlethwayayte.
Water Pollution Control, Vol 68, No 2, p 256-274, March-April 1969. 3 fig, 6 tab, 13 ref.

Descriptors: *Water, *Waste water, *Water pollution, Sewage, Biochemical oxygen demand, *Waste water treatment.
Identifiers: *Water economy, *Artesian basins, *Bacteriological pollution, Beach pollution, Paper industry waste, Pollution control, Deoxygenation.

Water supply and sewage in Australia and its hydrology is compared broadly with that of Europe. It is observed that interest in water supply, largely surface water, is mainly confined to aspects of quantity, rather than quality. But sewage treatment has received a greater share of attention. In 1965 about 60 percent of the sewage flow was being treated before discharge to final disposal areas. Water pollution in Australia is not very serious when compared with data available from European sources. Problems caused by urban run-off and sewage from unsewered areas are comparatively widespread but are given poor attention. Water resources management is also gaining importance with the setting up of the Water Research Foundation of Australia in 1955 and of Australian Water Resources Council in 1963. The author is hopeful that with growing post graduate activity in public health engineering, the present general and specific water engineering problems could be solved to a greater extent. (Shankar-Texas)
W70-06615

SIMPLIFIED MATHEMATICAL PROCEDURE FOR DESIGNING POST AERATION SYSTEMS,
Rex Chainbelt, Inc., Milwaukee, Wis. Process Equipment Div.
Richard A. Kormanik.
Journal of the Water Pollution Control Federation, Vol 41, No 11, Part I, p 1956-1958, Nov. 1969.

Descriptors: *Aeration, *Dissolved oxygen, Effluent, Design, Waste water treatment.
Identifiers: *Oxygen transfer coeffieient, *Post-aeration, Steady-state, Mass-balance, Surface aeration, Horsepower.

The development of a design procedure is presented for mathematically determining the basin size and the mechanical surface aeration horsepower required to bring a pretreated waste having an initially low DO level to the higher level required by the receiving waters. The procedure outlined takes into account the oxygen-utilization rate of the waste effluent as well as other parameters such as flow, temperature, and the waste effluent-oxygen transfer coeffieient corrections. The design equation presented will produce a post aeration system design which will be only as reliable as the design procedure. The developed design equation indicates that when the waste effluent flow is considered to have an oxygen-utilization rate equal to zero, the post aeration basin detention time does not become a design parameter. With an oxygen-utilization rate taken into consideration, the aeration horsepower requirement becomes directly proportional to the detention time. A sample calculation is also given. (Shankar-Texas)
W70-06616

FIELD EVALUATION OF THE PERFORMANCE OF EXTENDED AERATION PLANTS,
Cincinnati Univ., Ohio. Dept of Environmental Health.
For primary bibliographic entry see Field 05D.
W70-06620

HYDRAULIC CONTROL UTILIZING SUBMERGED EFFLUENT COLLECTORS,
Brown and Caldwell, Alhambra, Calif.
For primary bibliographic entry see Field 05D.
W70-06623

AERATION IN WASTE WATER TREATMENT--MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washington, D.C. Technical Practice Committee.
For primary bibliographic entry see Field 05D.
W70-06632

AERATION IN WASTE WATER TREATMENT - MANUAL OF PRACTICE NO. 5.
Water Pollution Control Federation, Washington, D.C. Technical Practice Committee.
For primary bibliographic entry see Field 05D.
W70-06633

CITY OF LOUISVILLE V TWAY (LOWER RIPARIAN OWNER CONTESTING DAMS ACROSS STREAM AND POLLUTION BY UPPER RIPARIANS).
For primary bibliographic entry see Field 04A.
W70-06664

DETERGENT ENZYMES: BIODEGRADATION AND ENVIRONMENTAL ACCEPTABILITY,
Monsanto Co., St Souis, Mo. Inorganic Chemicals Div.
R. D. Swisher.
BioScience, Vol 19, No 12, p 1093-1094, 1969. 2 tab, 5 ref.

Descriptors: *Biodegradation, *Detergents, *Enzymes, Environmental gradient, Cultures.
Identifiers: Bacillus subtilis, Protease activity, Enzyme SG-2331.

An assessment of the biodegradability of enzymes incorporated into laundry detergents was made. Observations were confined to a composite representative of commercial ingredients, produced from Bacillus subtilis (SG-2331). Trials conducted in shake-cultures, river water, and sewage with both alkaline and neutral proteases suggested that the rapid biodegradability of the detergent's enzyme would preclude unfavorable environmental reactions. (Wilde-Wisconsin)
W70-06673

ECONOMIC EVALUATION OF WATER QUALITY: A MULTICOMPONENT MODEL OF OPTIMAL QUALITY CONTROL IN ESTUARINE WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Shishir K. Mukherjee.
SERL Report No 69-2, January 1969. 103 p, 11 fig, 17 tab, 44 ref, 3 append. FWPCA Grant WP-597-05.

Descriptors: *Optimization, *Water quality control, *Estuaries, *Economic feasibility, Linear programming, Dispersion, Water allocation (Policy), Waste treatment, Operations research, California.
Identifiers: Multicomponent model.

The objectives of the study were to utilize operation research techniques to determine the economic effects of changing water quality requirements of an estuarine water basin. Dispersion models were developed for estimating the optimal allocation of water quality in an estuary to achieve various related objectives. Optimal control theory was used to solve the continuous versions of these models and obtain an insight into the nature of optimal discharge policies. The study sought to remove the limitations of an earlier linear programming model by developing an integrated multicomponent model of dispersion and waste treatment. This model simultaneously provided an optimal plan of water treatment, along with a plan of optimal waste discharge into the estuary. (See also W70-06685 thru W70-06688). (Thiuri-Cornell)
W70-06684

LINEAR OPTIMAL CONTROL THEORY AND THE CONTINUOUS DISPERSION MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Shirshir K. Mukherjee.
In: SERL Report No 69-2, Chap IV, p 23-47, January 1969. 25 p, 5 fig, 1 tab. FWPCA Grant WP-597-05.

Descriptors: *Optimization, *Dispersion, *Estuaries, *Water quality control, Discharge measurement, Cross-sections, Volume, Hydrologic properties, Flow measurement, Physical properties, Pollutants.

The general solutions of steady state dispersion models, reformulated as linear optimal control problems with state variable constraints, were presented. Four specific problem situations were discussed, ie., linear optimal control problem, minimum principle for linear optimal control problem, transversality conditions, and linear optimal control problem with state variable constraints. Basic results of linear optimal control theory and the related minimum principle were developed. Solutions were obtained for the continuous versions of the models by applying optimal control theory. The behavior of the optimal discharge policy in relation to the functions representing hydrological variables such as volume flow and cross-sectional area of the estuary was discussed. (See also W70-06684). (Thiuri-Cornell)
W70-06685

MATHEMATICAL PROGRAMMING FORMULATION OF THE DISPERSION MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Shishir K. Mukherjee.
In: SERL Report No 69-2, Chap V, p 48-61, January 1969. 14 p, 1 fig, 3 tab. FWPCA Grant WP-597-05.

Descriptors: *Linear programming, *Estuaries, *Estimating, *Optimization, *Dispersion, Sampling, Diffusion, Approximation method, Discharge (Water), Velocity, Prices, Computer programs, Cross-sections.
Identifiers: Steady state models, Nonsteady state models, Discrete models.

Discrete linear programming models were developed to estimate estuaries dispersion coefficients, using the data available from sampling studies of the estuary. Linear programs were generated to take advantage of the fast computer routines available for the solution of linear programming problems. The nonsteady state models, which gave rise to distributed parameter optimal control problems in the continuous case, were also formulated as linear programs under discrete approximation. An alternative approach of representing the steady state models as linear programs was described. The estuary was divided into small longitudinal sections using the solution of the diffusion equation in each of them to generate coefficients for the linear programs. The solution obtained estimated the optimal values of cross-sectional area, dispersion coefficient, advective velocity, constituent concentration, constituent discharge rate per unit of time within each reach of the estuary and the dual shadow prices. (See also W70-06684). (Thiuri-Cornell)
W70-06686

THE WASTE TREATMENT MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Shishir K. Mukherjee.
In: SERL Report No 69-2, Chap VI, p 62-67, January 1969. 6 p, 1 tab. FWPCA Grant WP-597-05

Descriptors: *Linear programming, *Waste water treatment, *Municipal wastes, *Industrial wastes, *Optimization, *Pollution abatement, Biochemical oxygen demand, Estuarine environment, Water quality control, Basins, Standards.

A linear programming waste treatment model was used to determine optimal treatment levels for all waste producing agencies in the region. The objective of the model was to minimize the regional treatment costs subject to stream quality standards. The quality of the water in the stream was characterized by the amount of chemical components such as phenols, biochemical oxygen demand, phosphate and nitrogen, present. The quality standards specified the maximum amount of each component that could be discharged at each plant. The decision variables were the amount of untreated effluent from each sector to be treated by each treatment method. The inequalities of a minimum regional cost approach were discussed and the use of effluent charges indicated by the shadow costs in the linear programming solution to encourage near-optimal treatment was suggested. (See also W70-06684). (Thiuri-Cornell)
W70-06687

SYNTHESIS OF THE DISPERSION AND WASTE TREATMENT MODELS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
Shishir K. Mukherjee.
In: SERL Report No 69-2, Chapter VII, p 68-77, January 1969. 10 p, 2 tab. FWPCA Grant WP-597-05.

Descriptors: *Waste treatment, *Dispersion, *Water quality control, *Optimization, Synthesis, Estuaries, Planning, Economics, Operating costs, Growth rates, Productivity, Flexibility, Equitable apportionment.
Identifiers: Multicomponent models.

A complete model of estuarine water quality management was obtained by a synthesis of the dispersion and waste treatment models. The multicomponent water quality model simultaneously provided optimal plans of treatment and discharge along the estuary. The economics of alternative methods of quality improvement and cost reduction schemes like transportation of waste from one section of the estuary to another or process changes were studied. Economic growth projections and other modifications like inclusion of social costs were also incorporated in this model. Dual prices could be used as a basis for a system of charges aimed at equitable distribution of operating costs among discharges, motivating them to reduce waste discharge by improving production and waste treatment processes. The main advantages of the model were its multicomponent nature, availability of standard computer codes for fast solution, direct output of optimum treatment plans, and flexibility regarding various objectives. (See also W70-06684). (Thiuri-Cornell)
W70-06688

A MODEL OF PUBLIC DECISIONS ILLUSTRATED BY A WATER POLLUTION POLICY PROBLEM,
Harvard Inst. of Economic Research, Cambridge, Mass.
Robert Dorfman, and Henry D. Jacoby.
In: The Analysis and Evaluation of Public Expenditures: The PPB System, Subcommittee on Economy in Government , Joint Economic Committee, 91st Congress, Wash, DC, May 1969, p 226-274. 4 fig, 9 tab, 11 ref.

Descriptors: *Water pollution control, *Mathematical models, *Decision making, Hydrologic aspects, Political aspects, Social values, Costs, Benefits, Economics.

A mathematical model of a water pollution problem was constructed to aid in the political decision making process. A hypothetical river basin was modelled to illustrate how a problem of governmental decision making could be expressed in a formal model and analyzed fruitfully. There were a variety of hydrologic technical, social, political, and economic issues invloved including conflicts of interest among the users of the basin's water resources. The model provided a useful way to manage the diverse kinds of data that were pertinent to the problem. The solution of the model defined both aggregate and individual user costs and benefits. It also provided a way to coordinate fragmented data and to analyze the effects of different assumptions that might reasonably be adopted. (Thiuri-Cornell)
W70-06690

06. WATER RESOURCES PLANNING

6A. Techniques of Planning

APPLICATION OF RUN-LENGTHS TO HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-06332

THE COVARIANCE MATRIX OF THE LIMITED INFORMATION ESTIMATOR AND THE IDENTIFICATION TEST,
Cornell Univ., Ithaca, N.Y.; and Purdue Univ., Lafayette, Ind.
Ta-Chung Liu, and William J. Brein.
Econometrica, Vol 37, No 2, p 222-227, April 1969. 6 p, 10 ref.

Descriptors: *Statistics, *Economics, *Estimation, Mathematical studies, Model studies, Maximization.

Identifiers: *Limited information, *Variance, *Econometrics, Likelihood estimator, Covariance matrix.

Two well known aspects of the limited information maximum likelihood method of estimating simultaneous equation systems are discussed. This method has potential use in water resource estimation problems and its clarification should be of use to the water resource planner. The author gives a straightforward derivation of the asymptotic covariance matrix of the limited information maximum likelihood estimator which yields results different from, and simpler than, the established formulae. The article also demonstrates that the statistical test of the validity of the a priori restrictions does not appear to yield satisfactory results. (Murphy-Rutgers)
W70-06417

DECENTRALIZATION IN SEPARABLE PROGRAMMING,
Louvain Univ. (Belgium); and Iowa State Univ., Ames.
Paul V. Moseseko, and Guy De Ghellink.
Econometrica, Vol 37, No 1, p 73-78, January 1969. 9 ref.

Descriptors: Statistical methods, Computer programs, Constraints, Prices.
Identifiers: *Decentralization, *Separable programming, Solutions, Subproblems, Concavity, Maximands, Convexity, Feasible sets.

The authors partition the feasibility constraints on a production economy into those specific to individual firms and those linking some or all of the firms. For a large class of separable programming problems, the authors provide simple proofs of propositions on the decentralization of such problems with the help of a set of prices for resources to which the linking constraints pertain. Regarding the generality of the results, the authors note that: (1) nowhere do they require differentiability of the functions involved; (2) nowhere must the individual constraint sets be functionally specified and the first proposition assumes neither concavity of maximands nor convexity of feasible sets. Here individual feasible sets might be, say, sets of discrete points. This article could be of interest to the water researcher involved in econometric methods where separable programming problems may prove applicable. (Loeb-Rutgers)
W70-06420

AN ECONOMIC INTERPRETATION OF OPTIMAL CONTROL THEORY,
Harvard Univ., Cambridge, Mass.
Robert Dorfman.
American Economic Review, Vol 59, No 5, p 817-831, December 1969. 1 fig, 8 ref.

Descriptors: *Capital, Economics, Time.
Identifiers: *Optimal control theory, *Capital theory, Calculus of variations, Maximum principle, Accumulation, Hamiltonians, Time paths.

Capital theory is the economics of time. Its task is to explain if, and why, a lasting instrument of production can be expected to contribute more to the value of output during its lifetime than it cost to produce or acquire. For the past fifty years capital theory has been perceived as a problem in the calculus of variations. The application of this conceptual tool to capital theory remained peripheral. In its modern version, the calculus of variations is called optimal control theory and it has become the central tool of capital theory. As a result, capital theory has been so transformed that it has been renamed growth theory, and has come to deal with numerous issues that previously could not even be formulated. The author's main thesis is that optimal control theory is formally identical with capital theory and that its main insights can be attained by strict economic reasoning. This thesis is supported by deriving the principal theorem of optimal control theory (the maximum principle) by means of economic analysis. In light of the importance of capital theory to water researchers involved with planning investments and management of capital budgets this article may prove to be relevant. (Loeb-Rutgers)
W70-06429

A TECHNICAL NOTE: DISCOUNTING THE GEOMETRIC SERIES,
University of Southern California, Los Angeles; and Bendix Corp., Southfield, Mich.
Gerald A. Fleischer, and Basil Mikkalkin.
The Engineering Economist, Vol 12, No 4, p 217-228, Summer 1967. 1 fig, 1 tab, 3 ref, 4 append.

Descriptors: Interest, Computer programs.
Identifiers: *Discounting, Geometric series, Compound interest tables, Present worth, Cash flows, Constant factor, Common ratio, Present value, Convergence.

Compound interest tables have long been used for the determination of equivalent values of money amounts. However, there is one especially useful discounting factor for which no tables have been published: the present worth factor for geometric series. This paper is directed to the presentation of several tables using representative values as well as a computer program which may be used for generating additional values. There are a number of real world phenomena in which successive cash flows do not increase by a constant amount, but rather increase or decrease by a constant factor. This factor, sometimes known as the common ratio, is determined by dividing any term of a geometric progression by the preceding term. The factor developed here may be used to convert a geometric series to an equivalent present value. This may prove valuable to the water researcher interested in determining the net present value of expected future benefits of purifying water when these benefits are expected to increase over time. (Loeb-Rutgers)
W70-06440

REMARKS ON ENGINEERING ECONOMY STUDIES FROM THE VIEWPOINT OF STATISTICAL DECISION THEORY,
Massachusetts Inst. of Tech., Cambridge.
Gordon M. Kaufman.
The Engineering Economist, Vol 12, No 1, p 23-29, Fall 1966. 6 p, 3 ref.

Descriptors: *Statistics, *Economic evaluation, *Decision making, Engineering, Economics, Management, Investment, Model studies, Mathematical studies, Statistical models.
Identifiers: *Statistical decision theory, Preference functions, Utility axioms, Discount rate, Present value, Decision theory.

The main contribution of statistical decision theory to the manager is that it gives him a framework for thinking about problem that requires him to be explicit about his preferences and his judgements about uncertain events and at the same time tells him how he should behave in order to be consistent with these preferences and judgements. When economics introduces uncertainty into a problem it becomes part of statistical decision theory. Given a set of acts, a set of states, a probability measure, and a preference function (and accepting the von Neuman-Morganstern utility axioms), the engineering economist is still faced with a number of practical problems which the author outlines. Difficulty in the application of these principles is due mainly to the need of simplifying the analysis and forcing the manager to think explicitly about the variables involved. Due to the necessity of making long run decisions involving varying degrees of risk in, especially, water utility management, this article should prove to be informative. (Murphy-Rutgers)
W70-06442

AN APPLICATION OF ACTIVITY ANALYSIS TO DEVELOPMENT PLANNING IN THE ELK RIVER AREA OF THE TENNESSEE VALLEY,
Tennessee Valley Authority, Knoxville.
Lawrence J. Mauer, and William W. Stevenson.
Land Economics, Vol 46, No 1, p 85-91, Feb 1970. 7 p, 1 tab, 6 ref.

Descriptors: *Long-term planning, Costs, Demand, Linear programming, Optimization.
Identifiers: *Activity analysis, Elk River area of Tennessee Valley.

The techniques and findings of a two-year econometric study devoted to development planning in the Elk River area, a subregion of the Tennessee Valley, are reported. The economic profile of the Elk River area is described. A highly disaggregated linear programming model was adopted for the formulation of an optimal economic development strategy for the area. The model is oriented towards the economic development of a sub-area of a national economy. The results of the study are presented. The conclusion states that a complex of highly interrelated manufacturing activities can probably be expected to demonstrate greater stability in the face of changes in cost and demand conditions than a colletion of individual, unrelated activities. (Grossman-Rutgers)
W70-06450

SYNTHESIS OF THE DISPERSION AND WASTE TREATMENT MODELS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06688

A MODEL OF PUBLIC DECISIONS ILLUSTRATED BY A WATER POLLUTION POLICY PROBLEM,
Harvard Inst. of Economic Research, Cambridge, Mass.
For primary bibliographic entry see Field 05G.
W70-06690

WATER RESOURCES SYSTEMS ANALYSIS, PART I: ANNOTATED BIBLIOGRAPHY ON STOCHASTIC PROCESSES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow, and Dale D. Meredith.
Available from the Dept of Civil Engineering. Civil Engineering Studies, Hydraulic Engineering Series No 19, July 1969. 80 p, 270 ref. OWRR Projects A-029-Ill and B-038-Ill.

Descriptors: *Bibliographies, *Water resources, *Systems analysis, *Stochastic processes, Storage, Queueing theory, Hydrology, Simulation analysis, Research and development.
Identifiers: Annotated bibliographies.

An annotated bibliography of 270 references on the use of stochastic processes in water resources systems analysis studies was presented. The objective was to develop a practical process by which the stochastic behavior of hydrologic characteristics could be simulated. The bibliography was subdivided into specific areas: (1) the mathematics of stochastic processes, (2) theories of storage and queues, and (3) application of stochastic processes in hydrology. Only references which had direct bearing on research objectives were selected. The bibliography covered items of basic significance to the subject matter. (Thiuri-Cornell)
W70-06698

WATER RESOURCES SYSTEMS ANALYSIS PART II: ANNOTATED BIBLIOGRAPHY ON PROGRAMMING TECHNIQUES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow, and Dale D. Meredith.
Available from the Dept of Civil Engineering. Civil Engineering Studies, Hydraulic Engineering Series

No 20, July 1969. 45 p, 121 ref. OWRR Project B-030-Ill.

Descriptors: *Bibliographies, *Water resources, *Systems analysis, *Linear programming, *Dynamic programming, Optimization, Resource allocation, Hydrologic properties, Planning.
Identifiers: Annotated bibliographies.

An annotated bibliography of 121 references on programming techniques was presented. Mathematical formulation of hydrologic systems and the various programming techniques for the optimization of the systems were described. The bibliography entries were divided according to the planning techniques used, ie., (1) linear programming, (2) nonlinear programming, (3) dynamic programming, and (4) other techniques. The bibliography covered items of basic significance to the subject matter and provided a valuable source of information to anyone engaged in research on water resources systems analysis. (Thiuri-Cornell)
W70-06699

WATER RESOURCES SYSTEMS ANALYSIS: PART III: REVIEW OF STOCHASTIC PROCESSES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow, and Dale D. Meredith.
Available from the Dept of Civil Engineering. Civil Engineering Studies, Hydraulic Engineering Series No 21, July 1969. 100 p, 84 ref. OWRR Projects A-029-Ill and B-038-Ill.

Descriptors: *Stochastic processes, *Water resources, *Systems analysis, *Hydrologic aspects, Simulation analysis, Markov processes, Queueing theory, Time series analysis, Storage, Risk, Investment, Planning.
Identifiers: Random walk.

Mathematical stochastic processes which have been applied or have potential applicability in hydrologic problems and water resources planning were reviewed. Practical procedures were discussed for simulating the stochastic behavior of a hydrologic system. The stochastic processes that were reviewed included the random walk, Markov Processes, queueing process, theory of storage and time series analysis. The generation of synthetic hydrologic data from historical records was discussed. Literature in the application of stochastic processes for solving water resources problems was cited and examples were given. It was concluded that stochastic methods were important in the economic analysis of water resources development. The use of stochastic models for generating hydrologic data allows the planner of water resources systems to estimate the benefits and risks associated with many alternative designs. (Thiuri-Cornell)
W70-06700

WATER RESOURCES SYSTEM ANALYSIS: PART IV: REVIEW OF PROGRAMMING TECHNIQUES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
Ven Te Chow, and Dale D. Meredith.
Available from the Dept of Civil Engineering. Civil Engineering Studies, Hydraulic Engineering Series No 22, July 1969. 70 p, 3 fig, 76 ref. OWRR Project B-030-Ill.

Descriptors: *Water resources, *Systems analysis, *Linear programming, *Dynamic programming, Simulation analysis, Optimization, Hydrologic systems, Planning, Mathematical studies.
Identifiers: *Geometric programming, *Game theory, *Quadratic programming.

Advanced methodologies for water resources planning including mathematical models of hydrologic systems and the various programming techniques for the optimization of these systems were presented. The techniques included linear programming, dynamic programming, geometric programming, quadratic programming, network theory, game theory, and simulation analysis. Literature on these techniques was cited and discussed. The report offered only a brief outline of the principles involved. The techniques were explained and examples of the problems which had been studied using the techniques were given in order to provide the water resource planner with a reasonably adequate description of the available modern mathematical programming techniques. (Thiuri-Cornell)
W70-06701

6B. Evaluation Process

INFLUENCE OF MAN ON THE HYDROLOGICAL CYCLE--GUIDE TO POLICIES FOR THE SAFE DEVELOPMENT OF LAND AND WATER RESOURCES.
Food and Agriculture Organization of the United Nations.

Int Conf, Food Agr Organ U N, Agenda Item 6.4.2, Paris, France, Dec 1969. 55 p, 2 fig, 107 ref.

Descriptors: *Policy matters, Natural resources, *Water resources development, *Policy development, Land resources, Arable land, Grasslands, Irrigation, Salinity, Drainage, Water pollution, Urbanization, Soil erosion, Landslides, Watersheds (Basins), Climatology, Hydrologic data, Soil conservation, *Hydrologic cycle, Land reclamation, Bibliographies.
Identifiers: Forestry land, Developing countries.

The many sciences and technologies involved in measuring hydrological results of changes in land use are discussed. Evidence from large-scale catchment studies of experimental changes in land use, as distinct from tests on small plots, although scarce, is reviewed. Subjects discussed include forest lands, grasslands, arable lands, irrigation, salinity, swamp drainage, urbanization, water pollution, and landslides. In technically advanced countries, the pressures of economic forces are rewarding the good and penalizing the bad land-use policies so that progressive improvement is occurring. Water pollution control, the most serious problem, will be achieved only at high cost with the support of strong public opinion. In the developing countries, rapid increases of population are resulting in an unplanned proliferation of subsistence agriculture, without the means of the discipline to protect the natural resources of vegetation, soils, and water. Provision of fertilizers and improved seeds, their local distribution, and provision of financial credit to permit their use are recommended to combat soil erosion. Discipline in the use of water resources for irrigation and their protection from pollution is advised; education alone is ineffective. (USBR)
W70-06370

GROUNDWATER RESEARCH IN THE U.S.A.,
Geological Survey, Washington, D.C. Water Resources Div.
C. L. McGuinness.
Earth-Science Reviews, Vol 3, No 3, p 181-202, September 1967. 22 p, 3 tab, 22 ref.

Desriptors: *Water resources development, *Groundwater, *Research and development, Injection wells, Transmissivity, Water level fluctuations, Water yield, Governments, Universities, Groundwater movement, Systems analysis, Model studies, Water resources research act.
Identifiers: Water resources research, Groundwater research.

Groundwater reservoirs and the overlying unsaturated zone have an enormous capacity to supply water to wells and useful plants, to store water to meet future needs, and to accept wastes. This capacity can be exploited on a maximum scale, however, only on the basis of information one or more orders of magnitude greater than that available at present on the distribution, recoverability, and replenishability of subsurface water. There is a critical need for research to devise methods of accomplishing these water-management tasks at reasonable cost. Among the chief target areas for research in subsurface hydrology are permeability distribution, including vertical permeability; prediction of the true value of the storage coefficient; theory of unsaturated flow based on fundamental soil characteristics that can be measured practicably; geochemical relations including the effects of injecting water of one composition into zones occupied by waters of different composition, generation of acid mine water, occurrence of saline water, and salt-fresh-water relations in coastal and other areas; prediction of the fate of wastes injected underground; geophysical techniques; and practical techniques of artificial recharge, especially through wells. (Knapp-USGS)
W70-06402

GEOLOGICAL INFORMATION FOR MANAGING THE ENVIRONMENT,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 06G.
W70-06403

ECONOMIC PROBLEMS IN SEPARATING THE DETERMINANTS OF RELATIVE PRICES,
Vanderbilt Univ., Nashville, Tenn.
G. S. Sahota.
International Economic Review, Vol 10, No 2, p 183-201, June 1969. 23 p, 21 ref, 6 tab.

Descriptors: *Prices, *Competition, *Monopoly, *Economic efficiency, Economic evaluation, Technology, Resource-allocation, Consumption, Industrial production, Marginal cost, Labor, Demand, Least-squares regression, Gross National Product, Value, Capital cost, Mathematical study, Costs.
Identifiers: *Oligopoly, *Technical progress, Internal competition.

There has been considerable discussion recently on the economic efficiency of the water utility industry in the context of public vs. private ownership and its affect on the consumer. This study should clarify some of the problems involved in this issue. A method is developed to separate the effects on the relative price of a product of relative intrafirm technical progress, interfirm resource-allocation improvements, scale economies and changes in input prices, on the one hand, from the effects associated with relative changes in internal competition or competition in the production of the product and external competition or competition in the consumption of the product. The method was applied to an empirical study of the oligopolistically controlled U.S. sulfur industry. The study indicated that a nine percentage point decline in the degree of monopoly resulted from an increase of internal competition. A reduction of about forty percentage points in the potential degree of monopoly was due to an increase of external competition. (Murphy-Rutgers)
W70-06408

FEDERAL AID TO THE STATES: AN ANALYTICAL EXAMINATION OF THE ALTERNATIVES,
Washington Univ., St. Louis, Mo.
For primary bibliographic entry see Field 05G.
W70-06410

A TREATISE ON THE USE OF EXPECTED VALUES IN WATER RESOURCE PROJECT EVALUATION,
University of Southern Mississippi, Hattiesburg.
D. L. Williams, and Donnie L. Daniel.
Water Resources Bulletin, Vol 5, No 3, p 50-56, September 1969. 7 p.

Descriptors: *Economic analysis, *Floods, *Water resource development, *Hurricanes, *Value, *Duration, Probability, Risks, Long-term planning,

Short term planning, Statistics, Damages, Costs, Conservation, Decision making.
Identifiers: *Expected value, *Natural disasters, *Time span.

There are two factors that influence the acceptability of the expected value criterion as a method of handling risk or uncertainty in decision making where damages from unusual physical occurrences such as hurricanes or floods must be considered. The length of time of project existence and the problem of obtaining accurate estimates of the probability of occurrence for different sizes of natural disasters must be solved. The latter problem is shown to be solvable with the probabilities not as high so as to make the use of the expected value criterion unwarranted. The time span of the project is more difficult. For projects with a continual, or long-term existence, the expected value approach is highly applicable. However, as a project becomes more short-term in nature, it is more a situation of uncertainty than one of risk. Therefore, the applicability of the expected value criterion for short-term analysis is suspect. (Murphy-Rutgers)
W70-06411

OPTIMAL PLANT UNDER CONDITIONS OF RISK,
Wesleyan Univ., Middletown, Conn.
T. M. Whitin.
Journal of Industrial Economics Vol XVII, No 2, p 81-85, April 1969. 5 p, 2 tab, 11 ref.

Descriptors: *Risks, *Probability distribution, *Economic evaluation, *Model studies, Demand, Interest rate, Costs, Optimization, Inventory, Uncertainty, Statistics, Economics.
Identifiers: *Optimal plant, *Production policy, Cost functions, Flexible plant, Entrepreneur, Time horizon.

The entrepreneur cannot select his optimal plant without explicit consideration of price, the probability distribution of demand, inventory level, and the discount rate. An optimal dynamic production policy is needed which indicates the optimal level of production for each level of initial inventory before an optimal plant selection can be accomplished. This indicates the impossibility of separating the cost and demand components of economic analysis. The model used to illustrate this theory is a stationary dynamic model with infinite time horizon, specified price, discount rate and two different plants represented by two simple and discrete cost functions. The model indicates that selection of an optimal plant depends on price level, demand, discount rate and production policy as well as the costs of alternatives studied in conventional economic analysis. This method serves as an optimizing procedure in the presence of risk, and is thus pertinent to the area of water resources where decisions on the optimal plant size are affected by the factors discussed in this article. (Murphy-Rutgers)
W70-06412

RETURNS TO SCALE, EULER'S THEOREM, AND THE FORM OF PRODUCTION FUNCTIONS,
Georgetown Univ., Washington, D.C.
F. W. McElroy.
Econometrica Vol 37, No 2, p 275-279, April 1969. 5 p, 3 ref.

Descriptors: *Economic analysis, *Mathematical studies, *Industrial production, Economic efficiency, *Input-output analysis, Economics of scale, Capital costs, Elasticity, Costs.
Identifiers: *Production functions, *Econometrics, *Euler's Theorem, Returns to scale, Homogeneity, Expansion paths.

By generalizing on Euler's Theorem, one can explain the classes of production functions for which scale elasticity depends either on output level alone or on factor proportions alone. Three classes of functions for which the nature of returns to scale, although not characterized by a single constant, can be described in terms of a function of a single variable. The analysis shows that the class of functions satisfying the first equation consists only of homogeneous functions and that those satisfying the second equation behave like homogeneous functions along each ray but the degree of homogeneity varies from ray to ray. The class of functions satisfying the other are the production functions for which all expansion paths are straight lines through the origin. The importance of understanding the production function in economic studies of the water supply industry makes this relevant reading for the water researcher. (Murphy-Rutgers)
W70-06413

FINANCING WATER UTILITY TRAINING,
Mahoning Valley Sanitation District, Youngstown, Ohio.
Donald D. Heffelfinger.
Journal of the American Water Works Association Vol 61, No 9, p 476-479, September 1969. 4 p.

Descriptors: *Financing, *Training, *Public utilities, *Costs, Technology, Economic efficiency, Education, Government, Management, Safety, Water supply, Schools, Instruction, Employment opportunities, Human resources.
Identifiers: *Water utilities, *Human capital, Manpower, Skills, Labor costs, Training costs.

Education and training results in the most effective use of manpower in the water utility industry. Rapid technological change brings prosperity and opportunity but it also brings problems of adjustment and demands for more knowledge. Continuous training of all water utility employees is needed for adaptation to technical changes. The government is aware of this need and is beginning to provide funds for training. Industry has long been aware of the problem and has provided for it, as have many large water utilities. The author states that the high cost of training should be considered a legitimate cost of operation and included in every operating budget, since it leads to greater economic efficiency. A breakdown of all the factors involved in training costs is given. The author feels that the number of personnel receiving training should be expanded. (Murphy-Rutgers)
W70-06414

SPECTRAL ANALYSIS OF DATA GENERATED BY SIMULATION EXPERIMENTS WITH ECONOMETRIC MODELS,
Duke Univ., Durham, N.C.
Thomas H. Naylor, Kenneth Wertz, and Thomas H. Wonnacott.
Econometrica, Vol 37, No 2, p 333-352, April 1969. 20 p, 46 ref.

Descriptors: *Economic evaluation, *Statistics, *Computers, Time series, Model studies, Economics, Mathematical studies, Income, Simulation analysis, Economic analysis, Probability, Stochastic processes, Estimation, Demand.
Identifiers: *Spectral analysis, *Econometrics, Confidence limits, Maximum likelihood.

The potential value of spectral analysis as a technique for analyzing data generated by computer simulation experiments with econometric models is demonstrated. The widespread use of this type of simulation in many water resource studies makes this article useful to the water researcher. By constructing the appropriate confidence bands, spectral analysis enables one to validate the output of simulation experiments and to compare the results of alternative economic policies associated with different series generated by an econometric model. The article discusses differences in the application of spectral analysis to series generated by computer simulation experiments and the application of spectral analysis to real world economic series. (Murphy-Rutgers)
W70-06416

NATURAL RESOURCE INFORMATION FOR ECONOMIC DEVELOPMENT,
Resources for the Future, Inc., Washington, D.C.
Orris C. Herfindahl.
Baltimore, Maryland, The Johns Hopkins Press, 1969. 212 p.

Descriptors: *Costs, *Hydrologic aspects, *Dams, *Data processing, *Economic evaluation, *Planning, *Surveys, Hydrologic data, Budgeting, Mapping, Geological surveys, Aerial mapping, Streamflow, Statistics, Health, River basin development, Statistical model, Floods, Natural resource development, Interest rate, Irrigation, Satellites, Land use, Regional analysis.
Identifiers: *Hydrologic gauges, *Economic development, Soil surveys, Mineral exploration, Agricultural surveys.

The problems involved in managing governmental programs that generate information about natural resources are studied. These problems are considered in relation to the more general problem of promoting economic development. There is a discussion of the role of natural resources in economic development, including an analysis of the process by which information comes to be generated and related to decisions on investment and production. The author then proceeds to examine some of the ways of gaining information about natural resources along with the capabilities and limitations of that information and the cost of acquiring it. Some guidelines for decisions on natural resource information programs are proposed, with consideration of the topics of time and the productivity of capital, location, and other factors needed to make effective use of natural resource information. Organizational problems are discussed in general terms as well as with special attention to the problems of some small countries. The importance of water resources in the natural resource area makes this book of interest to the water resource planner. (Murphy-Rutgers)
W70-06418

SOME NOTES ON THE ELASTICITY OF SUBSTITUTION,
Colorado Univ., Boulder.
Frank S. T. Hsiao.
American Economic Review, Vol LIX, No 3, p 432-435, June 1969. 4 fig, 7 ref.

Descriptors: Economics, Capital.
Identifiers: *Elasticity of substitution, Curvature, Factor space, Production function, Uneconomic region.

The first part of this paper demonstrates that the use of the concept of curvature is useful in checking some properties of the elasticity of substitution between two factors. In particular, it is shown that C S Soper's recent discussion on the elasticity of substitution in a noneconomic region can be derived easily from the method presented here. The second part of the article illustrates the elasticity of substitution in a per capita output-per capita capital diagram. The author contends that this may be thought of as a counterpart to Ronald Jones' diagram in his article found in the American Economic Review, September 1965. This article may be of value to the water researcher attempting to find the elasticity of substitution between factors used in water production and supply functions. (Loeb-Rutgers)
W70-06421

BEHAVIOR OF THE FIRM UNDER REGULATORY CONSTRAINT,
Purdue Univ., Lafayette, Ind.
Akira Takayama.
American Economic Review, Vol LIX, No 3, p 255-260, June 1969. 1 fig, 8 ref.

Descriptors: Regulation, Constraints, Investment, Capital.
Identifiers: *Firm, *Regulation constraint, Rate of return, Regulated industries, Marginal products.

In a recent article H Averch and L O Johnson, writing on the fair rate of return regulation in public utilities industries (or more generally 'regulated' industries), argue that the introduction of an 'active' constraint of a fair rate of return type would induce the firm to invest more than the original profit maximization value of capital, and this would create an inefficient allocation of inputs. The present author contends that Averch and Johnson's arguments are sketchy and contain somewhat ambiguous logic at several points. Although the author agrees with their conclusion, that a firm will tend to increase its investment with the introduction of an active constraint, he argues that it does not follow from their arguments. The author contends that a serious error arises from confusing movements along a curve and shifts of a curve. The present article clarifies those ambiguities and corrects the mistakes. A new formulation of the problem is provided which gives the same answer as Averch and Johnson, namely that a firm will tend to invest more with the introduction of an active constraint. This concept may prove helpful in the water area by indicating the effect of regulation on investment. (Loeb-Rutgers)
W70-06422

OUTPUT OF THE RESTRAINED FIRM,
Ohio State Univ., Columbus.
Milton Z. Kafoglis.
American Economic Review, Vol LIX, No 4, p 583-589, September 1969. 2 fig, 6 ref.

Descriptors: Prices, Monopoly, Costs, Profit, Income, Welfare.
Identifiers: *Output, *Restrained firm, Price discrimination.

The price and output behavior of the restrained monopoly firm are examined. H Averch and L Johnson have examined the impact of a regulatory restraint on the behavior of the monopoly firm whose management has a preference for profits. Models describing firms which voluntarily restrain profits have been developed by O. Williamson under the assumption of a managerial preference for expense and by W. Baumol under the assumption of revenue preference. These alternative formulations of the restrained firm reveal wide variations in price and output behavior. However, they do not reveal the range of possibilities when costs are increasing, when the firm seeks to maximize output or scale of operations, or when the firm employs price discrimination. Under these circumstances the output of the restrained monopoly may exceed that predicted by existing models and may even be pushed beyond an optimum as a result of sales at prices below marginal costs. This prediction of excess monopoly output, even in restrained or regulated situations, is the opposite of what we generally expect. This article may prove useful in the water area where 'firms' are restrained with respect to prices and rates. (Loeb-Rutgers)
W70-06423

PARETO OPTIMAL REDISTRIBUTION,
Virginia Univ., Charlottesville; and Pennsylvania State Univ., State College.
Harold M. Hochman, and James D. Rodgers.
American Economic Review, Vol LIX, No 4, p 542-557, September 1969. 5 fig, 7 tab, 13 ref.

Descriptors: *Taxes, Progressive taxes, Income, Welfare, Transfer.
Identifiers: *Pareto optimality, *Redistribution, Income redistribution, Utility interdependence, Tax burden, Fiscal incidence, Efficiency, Transfer-elasticity.

On trying to reconcile income redistribution with consumer sovereignty and an individualistic interpretation of the fiscal and political processes, the authors experimented with alternative hypotheses about utility interdependence. In the presence of such interdependence, Pareto optimality may not only be consistent with redistribution, but may require it. If so, the necessary fiscal adjustments depend on the implicit transfer-elasticities and the shape of the size distribution of income. Pursuing this line of thought, the authors have calculated, for several situations, the patterns of tax burdens, transfers, and fiscal incidence that would be Pareto optimal. The authors also tried to determine the type of utility interdependence that is implied by the actual fiscal residuals prevailing in the United States in 1960, on the assumption that those residuals were Pareto optimal. This may prove relevant in the water area in the event that income redistribution effects the demand for water, and also to the extent that water investments have distributional effects. (Loeb-Rutgers)
W70-06424

ATTITUDE DIMENSIONS OF LEISURE,
City Coll., New York.
John Neulinger, and Miranda Breit.
Journal of Leisure Research, Vol 1, No 3, p 255-261, Summer 1969. 1 tab, 10 ref.

Descriptors: *Attitudes, Recreation, Psychological aspects.
Identifiers: *Leisure, Attitude dimensions, Work, Free time, Factor analysis, Leisure planning.

The authors are not concerned with leisure activities per se, but rather in how people want to spend their money and how much satisfaction they get from spending it. The authors are not concerned with establishing a definitive meaning of leisure but rather with determining what leisure means to different people. Accordingly, this paper investigates people's attitudes toward leisure. Since a person's attitude tends to be part of his integral value system, the authors include in their investigation concepts closely related to leisure such as work, free time, and recreation. The purpose of this paper is to report on the construction of an instrument designed to measure leisure attitudes. Results of the anlysis indicate seven dimensions in which people may differ in their attitude toward leisure. This type of analysis concerned with attitude towards leisure can be helpful to the water researcher concerned with managing and predicting future needs for outdoor recreation facilities that involve water oriented recreation activities. (Loeb-Rutgers)
W70-06425

COMPUTER GRAPHICS FOR DECISION MAKING,
International Business Machines Corp., Poughkeepsie, N.Y.
Irving M. Miller.
Harvard Business Review, p 121-132, November-December 1969. 6 fig.

Descriptors: *Decision making, Computers, Costs, Demand, Profit, Industrial production.
Identifiers: *Computer graphics, Graphs, Display system, Electronic aids, Marginal revenue.

Computer graphics for business decision making is a relatively new technique whereby an executive creates and analyzes graphs relating to business decisions by direct interaction with a computer that has been programmed to produce these curves on a visual output screen. Graphic techniques have been used for some time by engineers and designers to analyze complex shapes. What is new today is the ability of computer programs to analyze economic and business decisions for executives who need not know how to manipulate complex mathematics. In most instances required programming skills are well within the capabilities of any corporation using computers. As such, computer graphics may prove to be very helpful to the water manager in aiding in the decision making process. Part I of this article describes the salient points of the graphic technique, and it demonstrates through illustrations how problems can be analyzed by computer graphics. Part II describes the actual display system and discusses the function and respective merits of standard electronic aids. Suggestions for developing programs and software requirements are given, along with estimates of the size of system needed. (Loeb-Rutgers)
W70-06427

BRINGING RESOURCE CONSERVATION INTO THE MAIN STREAM OF AMERICAN THOUGHT,
Forest Service (USDA), Ogden, Utah.
S. Blair Hutchinson.
Natural Resources Journal, Vol 9, No 4, p 518-536, October 1969.

Descriptors: *Conservation, Resources, Natural resources, Employment, Costs.
Identifiers: Resource conservation, Awareness, Social problems, Resoource problems, Resource management, Rural economies, Renewable resources, Resource values.

The failure of the United States to efficiently handle its natural resources is discussed. This failure has developed in large part from the lack of broad public awareness of what is happening with the consequent failure to develop strong programs for dealing with social and resource problems. The opposition of those using the resources who would be disadvantaged by more effective conservation policies has also been important. The thesis behind this paper is that the failure of the American people to respond more aggressively to the needs of conservation is primarily because the issues have never been properly described. The author presents three needs which should be fulfilled: (1) to relate the renewable natural resources and their management to the goals of our society; (2) to develop and gain acceptance of a comprehensive code defining the responsibility of society in relation to its resources; and (3) to develop clear objectives as anchor points for management decisions. These objectives would all be consistent with management programs in the water area. (Loeb-Rutgers)
W70-06428

LONG-RUN SCALE ADJUSTMENTS OF A PERFECTLY COMPETITIVE FIRM AND INDUSTRY,
Texas A and M Univ., College Station.
C. E. Ferguson, and Thomas R. Sauing.
American Economic Review, Vol 59, No 5, p 774-783, December 1969. 2 fig, 8 ref, 1 append.

Descriptors: *Competition, Expenditures, Prices, Marginal Costs, Average costs, Supply, Demand.
Identifiers: *Long-run scale adjustments, *Perfect competition, Output, Elasticity, Expenditure elasticity, Factor price, Supply price, Income elasticity, Substitution effect, Expenditure effect, Income effect.

The objective is to prove the following propositions for perfectly competitive firms and industries: (a) a firm's short- and long-run output adjustment to a change in factor price depends upon the expenditure elasticity of the factor, not upon its normality or inferiority; (b) regardless of the change in marginal cost, average cost must vary directly with factor price; (c) hence the long-run supply price of a perfectly competitive industry must vary directly, and its output inversely, with factor price. The authors also show that (a) from the production side, the relation between supply and expenditure elasticity is analogous to the relation between demand and income elasticity in the theory of consumer behavior; (b) derived input demand functions have substitution and expenditure effects that are analogous to the substitution and income effects in the theory of demand; and (c) long-run average cost is always inelastic with respect to factor price. Theoretical micro economic analysis is employed to discuss the problems of the water 'market.' The article contributes to the basic understanding of micro theory and is relevant to theoretical presentations of economic issues in water supply and demand problems. (Loeb-Rutgers)
W70-06430

TOWARD A THEORY OF MULTIPLE USE: THE CASE OF RECREATION VERSUS AGRICULTURE,
British Columbia Univ., Vancouver.
Peter H. Pearse.
Natural Resources Journal, Vol 9, No 4, p 561-575, October 1969. 3 fig.

Descriptors: *Recreation, Income, Resource allocation, Competing uses, Ranges, Cattle, Deer, Investment, Benefits, Natural resources, Welfare.
Identifiers: *Multiple use, Transformation curve, Resource improvement, Resource management.

The problem of simultaneous and conflicting uses of a natural resource is discussed. The assumed objective has been one of maximizing the contribution of the resource to the welfare of the social group in whose interest it is managed. The author demonstrates the kind of information required to fix the socially-optimum combination of conflicting uses of a resource. As increasing demands are placed on rural resources, there will be more and more cases in which the most efficient management regime will involve providing for two or more uses at once. There appears, therefore, to be an urgent need to clarify the criteria for establishing optimum combination of uses. This article attempts to throw some light on the conceptual problems involved. The author argues that these problems suggest a wide scope for research bringing together the combined expertise of biologists and economists. The theory of multiple use may find wide applications in the water area where often water facilities are competitive in more than one use. (Loeb-Rutgers)
W70-06431

ON THE SOCIAL RATE OF DISCOUNT: COMMENT IV,
Missouri Univ., Columbia.
David D. Ramsey.
American Economic Review, Vol 59, No 5, p 919-924, December 1969. 6 ref.

Descriptors: Discount rate, Taxes, Risks.
Identifiers: *Social rate of discount, Weighted average, Rate of return, Time preference.

Using the formula developed by Baumol, the author shows that his conclusions are special cases of a general case. The following results emerge from the analysis: (1) the social rate of discount is a weighted average of observable pre-tax market rates of return and is not directly observable. The 'weights' depend on how individuals in the private sector react to the transferral of resources. (2) Both risks and time preferences are given their appropriate consideration in this 'weighting' process and neither need to be explicitly considered again. The question about what is the appropriate rate of discount then becomes an empirical one. Section I analyzes the social rate of discount when there are no risks in the economy and time preferences are ignored. Risks are introduced in Section II and time preferences in Section III. This discussion is relevant to questions concerning what discount procedure to use for water investment projects. (Loeb-Rutgers)
W70-06432

ON THE SOCIAL RATE OF DISCOUNT: COMMENT I,
Central Michigan Univ., Mount Pleasant.
Alan Nichols.
American Economic Review, Vol 59, No 5, p 909-911, December 1969. 3 ref.

Descriptors: Taxes, Distribution patterns.
Identifiers: *Social rate of discount, Time preference rate, Opportunity cost, Consumption, Rate of return, Borrowing.

The author contends that the recent article by W. J. Baumol errs in the handling of social opportunity costs. Baumol concludes that if r is the public's time preference rate for consumption, 2r will be the opportunity cost of transfer. The author objects to the idea that it makes no difference whether resources are transferred by borrowing or by taxation. The difference between attracting resources from consumption, as would be the case with taxation, and attracting resources from saving, as in the case with government security issue, is that a larger quantity of resources would be passed to the future if the taxation route is followed. Thus, if the question is the shift of resources to future generations, it does make a difference which route is taken. The different routes have different distributional consequences among generations. The author also contends that the correct rate to use in Baumol's framework is the opportunity rate, 2r. The social discount rate plays an important role in evaluating water resource investments and this article is relevant to researchers concerned with the role of the discount rate in water projects. (Loeb-Rutgers)
W70-06433

ON THE SOCIAL RATE OF DISCOUNT: COMMENT II,
State Univ. of New York, Stony Brook.
Estelle James.
American Economic Review, Vol 59, No 5, p 912-916, December 1969. 1 fig, 5 ref.

Descriptors: Taxes, Marginal return, Investment, Interest, Risks.
Identifiers: *Social rate of discount, Corporate income tax, Time preference, Opportunity cost, Consumption.

In Baumol's recent article, the corporate income tax is shown to create a divergence between the marginal rate of return to private investment, on the one hand, and the subjective time preference or government borrowing rate, on the other. Baumol claims that the former constitutes the opportunity cost of capital and hence the optimal social discount rate for evaluating public projects whether the resources used have been diverted from private investment or consumption. The author presents an anlysis which suggests somewhat contrasting conclusions. This article is relevant to water investment projects using the social discount rate concept. (Loeb-Rutgers)
W70-06434

NATURAL LANDSCAPE PREFERENCES: A PREDICTIVE MODEL,
Forest Service (USDA), Syracuse, N.Y.
Elwood L. Shafer, Jr., John F. Hamilton, Jr., and Elizabeth A. Schmidt.
Journal of Leisure Research, Vol 1, No 1, p 1-19, Winter 1969. 4 fig, 3 tab, 4 ref.

Descriptors: *Forecasting, Photography, Natural resources, Preferences, Regression analysis.
Identifiers: *Natural landscape preferences, Landscape.

In trying to cope with the problem of landscape abuse and destruction, one of the questions that natural resource planners frequently ask is: 'Why is one landscape preferred more than another.' An experiment was recently conducted using black and white photographs of landscapes. The purpose of the study was to identify what quantitative variables in a natural landscape are significantly related to public preference for that landscape. By knowing what quantitative features in a landscape affect its aesthetic appeal, natural resource planners can make decisions on a factual basis about purchasing, developing, or preserving these features. The experiment indicates that preference for a landscape depends on the area or perimeter measurements of six items within a photograph. These six photographic items can be measured easily by resource planners, and can be used to help evaluate and compare the aesthetic quality of different landscapes. The method is applicable in many areas of natural resource management and planning, from wilderness aesthetics to scenic road designs. This may prove helpful to the water researcher in attempting to determine, for example, how much and what type of water resource to develop for recreation purposes. (Loeb-Rutgers)
W70-06435

A TECHNIQUE FOR DETERMINATION OF PROJECT PRIORITY WHEN CONSIDERING IRREDUCIBLES,
University of Southern California, Los Angeles.
Gerald A. Fleischer.
The Engineering Economist, Vol 11, No 2, p 13-28, Winter 1966. 17 p, 27 ref, 6 tab.

Descriptors: *Economic evaluation, *Economic efficiency, Engineering, Investment, Costs, Optimization, Priorities, Value, Marginal utility, Monetary value, Decision making.
Identifiers: *Irreducibles, Simple order, Order on distribution, Numerical scale, Utility, Lexiographic ordering, Pareto optimality.

In addition to the inclusion of economically measurable consequences of prospective alternatives in all engineering-economic analysis, those consequences which cannot feasibly be reduced to monetary terms should also be considered. This paper suggests a technique which can be used to include irreducibles along with monetary data in determining relative desirability of mutually exclusive alternative proposals. The author discusses the three degrees of measurement possible; simple order, order on distances and a numerical scale. The article explains each, and provides several examples of each. The author feels that it is impossible to generate single-valued numerical properties which reflect true utility but this is not disastrous since the engineering-economist may be content with the establishment of priorities, not values. This article should aid in the economic evaluation of alternative water resources projects which have difficulty in evaluating the monetary benefits associated with all their uses. (Murphy-Rutgers)
W70-06436

AN EXPERIMENTAL ASSEMBLY LINE SYSTEM FOR EVALUATING POTENTIAL INVESTMENTS,
California Univ., San Diego, La Jolla, Calif.
Richard L. Norgard.
The Engineering Economist, Vol 11, No 2, p 29-47, Winter 1966. 19 p, 6 ref.

Descriptors: *Economic evaluation, *Investment, *Decision making, *Forecasting, Economic efficiency, Value, Marginal cost, Capital, Optimization, Cost minimization, Budgeting, Income, Statistics, Model studies, Demand, Monte Carlo study, Frequency distribution, Average cost, Engineering, Management, Risks.
Identifiers: *Assembly-line method, *Rate of return, *Einheits.

This article seeks to develop a model for systematically evaluating capital expenditures which can maximize the reuse of data and analyzes from one proposal to another, utilize the talents of the entire organization, and systematically measure uncertainty. The article is also concerned with describing the reaction of business managers to the model after it had been experimentally applied to a specific potential investment project. The author proposes an assembly-line system, which is shown to handle capital budgeting problems efficiently and makes a substantial improvement in the quality and quantity of analysis. Once this method is organized, the marginal cost of analyzing investments is small. This method could prove applicable to evaluating techniques of water resource investment projects. (Murphy-Rutgers)
W70-06438

EVALUATION OF INVESTMENTS IN WATER RESOURCES MANAGEMENT,
Wisconsin Univ., Madison. Water Resources Center.
Irving K. Fox.
American Water Works Association Journal, Vol 59, No 8, p 913-918, August 1967.

Descriptors: *Economic evaluation, *Political aspects, Water resources, Investment, Government, Financing, Flood control, Benefits, Value, Management, Income, Transportation.
Identifiers: *Program alternatives.

Past literature that attempts evaluation of water resource programs in the United States is cited. These studies have not been entirely successful and the limitations of the techniques of economic analysis are discussed. An important problem discussed here is that of making information available to the public in order to make value judgments. In addition, the four major obstacles preventing the presentation of alternatives for public consideration are discussed along with the kinds of measures which will aid in their solution. The author feels that evaluation of public programs in the final analysis is a political function. Attention should be given to improving the capability of the political institution to perform its evaluation function. (Murphy-Rutgers)
W70-06439

ECONOMIC COMPARISON OF PROJECTS INCORPORATING A UTILITY CRITERION IN THE RATE OF RETURN,
California Univ., Los Angeles.
J. M. English.
The Engineering Economist, Vol 10, No 2, p 1-14, Winter 1965. 2 fig, 8 ref.

Descriptors: *Risks, Decision making, Economics, Costs, Income, Investment, Probability.
Identifiers: *Economic comparisons, *Utility, *Rate of return, *Discount function, Decision theory, Present worth, Engineering economy.

Economic analyses of engineering projects have usually been made on the basis of deterministic methods of traditional engineering economy. Only recently have serious attempts been made to introduce aspects of risk and uncertainty explicitly into the methodology. The new methods are based on the principles of decision theory. The purpose of this paper is to develop a discount function by which future money prospects can be weighted for purposes either of economic comparison of competing investment opportunities, or of evaluation of a projected undertaking. This discount function takes account of risk which is related to the utility function of the investor. It considers his attitude toward risk and his preference for safe or risky investments. This article would be applicable to the water area where investment decisions clearly contain uncertainties and risks. (Loeb-Rutgers)
W70-06441

SENSITIVITY ANALYSIS--A CASE STUDY OF THE PIPELINE INDUSTRY,
Texas A and M Univ., College Station.
William C. House, Jr.
The Engineering Economist, Vol 12, No 3, p 155-166, Spring 1967.

Descriptors: *Capital, *Investment, *Decision making, Risks, Costs, Income.
Identifiers: *Sensitivity analysis, Pipeline industry, Rates of return.

Capital investment decisions are among the most critical decisions that management must make. Decisions by the management of business firms for investment capital are often made largely on the basis of whether estimated rates of return are acceptable or not. Errors by management in estimating such underlying elements as sales volume, sales price, operating expenses, and project economic life may cause estimated rates of return to be higher or lower than actual rates of return. Errors in estimates can not be totally eliminated. It is possible, however, to determine the significance of such errors and thereby more clearly identify the risks involved in accepting a given investment proposal. It is likely that decisions to accept specific proposals in a number of industries are sensitive to errors in only a few of the many estimates which are used to calculate rates of return. If it can be established that the decisions to accept a given type of proposal are sensitive to errors in certain estimates, then management can concentrate its data-gathering and evaluation efforts on these estimates and thereby obtain the greatest improvement in capital investment decision making for the least expenditure of time and money. For example, an illustrative capital investment decision in the oil and pipeline industry is presented. This paper would be of interest to the water researcher or planner involved in investment decisions. (Loeb-Rutgers)
W70-06443

THE ECONOMIC IMPACT OF TVA.
Tennessee Univ., Knoxville.

Edited by John R. Moore. Knoxville, University of Tennessee Press, 1967. 163p.

Descriptors: *Economic impact, *TVA, *Water resource development, *Natural resource development, Cost benefit analysis, Decision making, Economic analysis, Industrial production, River basin development, Multipurpose projects, Planning, Capital, Prices, Watersheds, Costs, Social aspects, Management, Flood control, Irrigation, Pollution, Recreation, Transportation.
Identifiers: *Underdeveloped areas, Agricultural extension, Economic development.

This volume begins with a consideration of the general question of the role of electrical energy in economic development and continues with a discussion and evaluation of the role that TVA has played in a number of important areas of transferring knowledge to underdeveloped areas, in developing natural resources, in illustrating the politics of water resource development and in the area of antitrust. Two papers attempt to assess in broad terms where TVA has been and to indicate possible lines of further development. The final essay is an inquiry into TVA's future, by its board chairman. He examines the potential contribution which TVA can make for the benefit of the people of the Valley region and of the nation as a whole. (See also W70-06445 and W70-06446). (Murphy-Rutgers)
W70-06444

TOWARD MORE REALISTIC ASSUMPTIONS IN REGIONAL ECONOMIC DEVELOPMENT,
Tennessee Univ., Knoxville.
Gilbert Banner.
The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967, p 121-143. 23 p.

Descriptors: *TVA, *Regional analysis, *Economic evaluation, Planning, Rivers, Multipurpose projects, Government, Income, Electric power, Agricultural production, Irrigation, Fertilizer, Costs, Employment, Navigation, Transportation, Water supply, Technology, Watersheds, Engineering, Economic analysis, Social aspects.
Identifiers: *Regional economic development, Federal agencies, Agricultural policy, Welfare economics, Industrial sites, Highway location.

This article is concerned with the problem of evaluating the TVA. The author, although sympathetic to TVA in its overall conception, raises a number of questions concerning the direction, scope and force of the TVA's activities. In many areas he finds shortcomings in the TVA record. The assumptions made by TVA concerning regional economic development were proved wrong and the TVA failed to make the necessary adjustments. The federal government has begun to assume its share of responsibility for the problems resulting from changes in the national economy and the policy options open to the TVA for regional economic development are discussed. The objectives to be pursued in the agricultural policy are outlined and the TVA's interest in the tributary watershed program is explained. The author feels that if regional resource development is to be pursued, substantial changes may be necessary in the institutional arrangements through which such problems are approached. (See W70-06444). (Murphy-Rutgers)
W70-06445

THE FUTURE OF TVA,
Tennessee Valley Authority, Knoxville.
Audbrey J. Wagner.
John R. Moore, Editor, The Economic Impact of TVA, Knoxville, University of Tennessee Press, 1967. P 145-160, 16P.

Descriptors: *TVA, *Pollution, *Flood control, *Transportation, *Recreation, *Economic analysis, Streams, Water supply, Waste, Treatment, Government, Electric power, Economic efficiency, Rivers, Planning, Forestry, Costs, Agricultural production, Income, Employment.
Identifiers: *Tennessee Valley, *Shoreline land, Zoning.

This paper examines the potential contribution which TVA can make for the benefit of the people of the Valley region and the nation as a whole. These benefits embrace a number of specific areas: electric power, development of industrial and recreational sites, the orderly development of lakeshore lands, flood control, forestry and agriculture. These areas are evaluated and explained in terms of the potential contribution of TVA in achieving the specified goals in the most economically efficient manner. The economic benefits arising out of past TVA policy are discussed both as testimony to the success of TVA and as an indicator of the problems still facing that agency. An observation is made that there are more highly developed institutions now available for dealing with the problems of a publically operated agency than were previously available. The obvious role of water use and development in the TVA experience make this article relevant to the water study area. (See W70-06444). (Murphy-Rutgers)
W70-06446

A CRITICAL ANALYSIS OF EMPLOYMENT PROJECTION METHODS: A TEST CASE OF NEW JERSEY,
Rutgers - The State Univ., New Brunswick, N.J. Water Resources Research Inst.
Daryl Hellman, and Matityahu Marcus.
Available from the Clearinghouse as PB-191 716, $3.00 in paper copy, $0.65 in microfiche. Partial Completion Report, May 1970. 225 p, 24 tab, 112 ref, 2 append. OWRR Project B-002-NJ (3).

Descriptors: *Statistical methods, Population, Employment, Growth rates, Regression analysis, Input-output analysis.
Identifiers: *Projection.

This study develops projections of employment to 1975 for SIC three-digit manufacturing industries in New Jersey. Some attention is devoted to the possibility of projections by regions of the state, but projections are not derived. The study begins with a brief review of approaches to regional analysis, followed by a detailed discussion of regional projection methodology, development of an explicit shift-share model of projection for New Jersey, and evaluation of the employment projections derived from the model via comparisons with other projection techniques. The comparisons suggest that the explicit shift-share approach is a reliable method for projecting employment in local market-oriented industries. For export industries the model does not perform as well as other, simpler models. Reasons for the relative performances are discussed. This study was prepared for purposes of water resources research. (Hellman-Rutgers)
W70-06448

REVIEW OF NEW GEOGRAPHIC METHODS AND TECHNIQUES. QUESTIONNAIRE SURVEY. WATER RESOURCE PLANNING AND MANAGEMENT. RECENT TRENDS IN REMOTE SENSING TECHNOLOGY,
Florida Atlantic Univ., Boca Raton. Dept. of Geography.

Robert J. Tata, Cecil E. Plamer, and Richard E. Witmer.
Available from the Clearinghouse as AD-700 176, for $3.00 in paper copy, $0.65 in microfiche. U.S. Army Engineer Topographic Research Laboratory. Final Technical report (Appendix C), Ft. Belvoir, Va. Oct. 69, 97 p., 3 Bibliographies. Contract DAAK02-68-C-0219.

Descriptors: *Geographical regions, Mapping, *Remote sensing, Photogrammetry, Terrain analysis, Telemetry, *Wafer resources development, Analytical techniques.
Identifiers: *Geography.

In doing work for a research project on new geographic methods and techniques, the three reports and bibliographies included in this study were developed. Because the reports are of interest, but not directly related, to the central goal of the methodological treatise, they are presented for researchers concerned. The first report summarizes the results of a questionnaire survey of geographers who are active in researching methodological topics; the second report deals with the geographer's role in studies of water resource planning and management; and the final study comprises report and bibliography on new systems of remote sensing techniques.
W70-06466

UPPER MISSISSIPPI RIVERWAY COMPACT (NEW).

Iowa Code Ann secs 27A.1-27A.6 (Supp 1970)

Descriptors: *Iowa, *Interstate compacts, *Mississippi River, *Interstate commissions, Interstate rivers, Conservation, Recreation, Economics, Taxes, State governments, Water resources development, Aesthetics, Parks, Scenery, Social aspects, Agriculture, Industries, Land use, Local government, Administration, Administrative agencies, Legislation, Regulation, Supervisory control (Power), Projects, Financing.

The Upper Mississippi Riverway Compact is dedicated to the purpose of a sound and attractive Upper Mississippi Region which blends aesthetics with agricultural, economic and industrial progress. The Region's territorial boundaries are outlined. The Upper Mississippi Riverway Commission is created and certain powers and duties are imposed, relating specifically to improving environmental conditons of the Region. The Commission is not subject to state taxation. Financing for the Commission's work is provided. Land and water use and their preservation shall be the subject of special consideration by the Commission. Advisory committees may be established to aid the Commission. Procedural provisions for enactment of the Compact and its effect are outlined. The membership and composition of the Commission is described. The provisions of this Compact shall in no way conflict with the function of local government. (Barnett-Florida)
W70-06485

THE GREAT LAKES WATER RESOURCE,
Federal Water Pollution Control Administration, Chicago, Ill. Great Lakes Region.
H. W. Poston, and C. R. Ownbey.
Journal American Water Works Association, Vol 60, No 1, p 15-20, 1968. 4 ref.

Descriptors: *Great Lakes, *Water resources, Water quality, Eutrophication, Lake Erie, Lake Ontario, Lake Michigan, Phosphates, Productivity, Fertilization, Chemicals, Dissolved oxygen, Stratification, Bacteria, Sewage effluents, Storm runoff, Sewers, St. Lawrence River, Lake Huron, New York, Michigan, Illinois, Wisconsin, Ohio, Indiana, Pennsylvania.
Identifiers: Canadian government, Ontario, Detroit (Mich), Calumet River (Ill), Fox River (Wis), Saginaw River (Mich), Cuyahoga River (Ohio), Maumee River (Ohio), Menominee River (Wis).

Lake Erie has the largest contributing population to degradation on its watershed and the largest discharger of municipal effluents undergoing only token nutrient reduction. Modification of treatment plant design and operating practices can reduce phosphate concentration in waste water to a high degree. Accurate measurement of productivity and efficient techniques for control of aquatic organisms are needed. Chemical constituents are increasing; for example, chlorides tripled from 1910 to 1960; oxygen depletion results from overstimulation of biological activity; health hazards along the shores prevail from inadequately disinfected sewage effluents. The largest single planning effort under way at present is the Great Lakes-Illinois River Basins study under the Federal Water Pollution Control Act. The international Joint Commission is also coordinating a study. Plans for local actions are formulated. The administrators' and policy makers' task will be to assure proper balance in the efforts directed to research, plans for action and application. Some acceptable institutional arrangement must be evolved to settle disputes between conflicting interests. An organization having authority to command effective action must be established, correlating efforts of physical scientists, engineers, economists, lawyers, and political scientists. A TVA of the Great Lakes is suggested. (Jones-Wisconsin)
W70-06658

ECONOMIC EVALUATION OF WATER QUALITY: A MULTICOMPONENT MODEL OF OPTIMAL QUALITY CONTROL IN ESTUARINE WATERS,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06684

LINEAR OPTIMAL CONTROL THEORY AND THE CONTINUOUS DISPERSION MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06685

MATHEMATICAL PROGRAMMING FORMULATION OF THE DISPERSION MODEL,
California Univ., Berkeley. Sanitary Engineering Research Lab.
For primary bibliographic entry see Field 05G.
W70-06686

FRANKLIN COUNTY COMPREHENSIVE PLAN.
Franklin County Planning Commission, Columbus, Ohio.

Available from the Clearinghouse as PB-189 024, $3.00 in paper copy, $0.65 in microfiche. Comprehensive Regional Plan of Columbus and Franklin Counties, Ohio. December, 1969. 141 p.

Descriptors: *Long-term planning, City planning, *Water resources development, Land use, Sewage, *Municipal wastes, Community development.
Identifiers: Franklin County (Ohio), Open space planning.

The report contains the comprehensive regional plan for Franklin County, Ohio and some adjacent areas. It documents development of the land use plan and summarizes four separate published reports on plan elements. Three generalized 1985 regional land use concepts are evaluated. Recommended standards and objectives for industrial, residential and commercial uses are stated together with a discussion of the legal and organizational problems associated with plan implementation.
W70-06710

REFUSE DISPOSAL IN DUTCHESS COUNTY, NEW YORK.
New York State Office of Planning Coordination, Albany.
For primary bibliographic entry see Field 05E.
W70-06711

6C. Cost Allocation, Cost Sharing, Pricing/Repayment

ECONOMIC ASPECTS OF HYDRO POWER,
Water Power Inc., London (England).
J. V. Hunter.
Water Power Vol 21, No 10, p 372, and 398, October 1969.

Descriptors: *Interest rate, *Economic evaluation, *Hydro power, Planning, Inflation, Thermal power, Loans financing, Costs, Economic efficiency, Capital costs, Cost-benefit analysis, Income, Operating costs, Cost minimization.
Identifiers: *Rate of return, Present value, Opportunity costs.

There is some confusion with regard to the effect of monetary inflation on hydroelectric development. The relative merits of hydro and thermal power should be assessed to ensure that the project chosen represents the best employment of available resources, labor, materials, and finance in order to achieve the objective at minimum cost. The usual method is to determine the present worth of the two cash streams involving costs and revenue. The author is concerned with the choice of an appropriate discount rate. Due to the long life and low operating costs of a hydro project this is important. The discount rate that is used should represent the opportunity cost of capital. It should also take into account the monetary inflation that will occur over the life of the project. The proper discounting procedure will mitigate many of the difficulties involved with planning for long periods of time. (Murphy-Rutgers)
W70-06407

A RISK-RETURN ANALYSIS OF A FIRM'S WORKING-CAPITAL POSITION,
Stanford Univ., Calif.
J. C. Van Horne.
Engineering Economist, Vol 14, No 2, p 71-89, Winter 1969. 19 p, 4 tab, 9 ref.

Descriptors: *Risks, *Capital, *Probability, *Debt, *Financing, Management, Costs, Decision making, Budgeting, Labor, Taxes, Economics, Statistics, Credit.
Identifiers: *Working-capital, *Debt structure, Opportunity costs, Liquid assets, Cash flow, Time horizon, Assets, Liabilities.

This article presents a method for managemental analysis of the risk-return tradeoff for various levels of liquid assets for a firm and the different maturity compositions of its debt. These factors determine the firm's working capital position. The technique involved utilizes various probability concepts and assigned risks, as well as the opportunity costs of the maneuvers involved. The purpose of the technique proposed is to make possible more rational working-capital decisions, thus enabling the firm involved to achieve a working-capital position with a sensible ratio between safety of that position and the costs in reaching it. This article is of interest to researchers in water resources since it discusses the important management costs and risks that are encountered in the workings of financial investment decisions. (Murphy-Rutgers)
W70-06409

APPLICATION OF LINEAR PROGRAMMING TO SHORT-TERM FINANCING DECISION,
British Columbia Univ., Vancouver.
J. C. T. Mao.
Engineering Economist, Vol 13, No 4, p 221-241, Summer 1968. 21 p, 2 fig, 5 tab, 5 ref.

Descriptors: *Decision making, *Capital costs, *Linear programming, *Financing, *Economic evaluation, Rate of interest, Computers, Costs, Budgeting, Optimization, Uncertainty, Value, Management, Taxes.
Identifiers: *Objective function, *Simplex algorithm, Marginal analysis, Commercial paper, Installment financing, Line of credit.

A linear programming model is applied to a financial decision case study of a seasonal industry. Imputed values and marginal analysis are used in this example, which is designed to demonstrate the structure and working of the model. The essential question being asked is how best to finance seasonal cash needs so as to minimize the cost of financing. The cash budget of an agency reveals anticipated cash drains. Three short-term financing alternatives exist; the problem is which will cost the least. Constraints on each alternative, and on the cash budget, are programmed and minimization of fund requirements is sought as the objective function. The program yields an optimal solution and includes imputed values and marginal analysis. The only stipulation in this method is the certainty of the cash budget. Since water resource projects are vitally concerned with allocated cash budgets and water supplying agencies do have seasonally conditioned changes, managers of these projects will find this model useful. (Murphy-Rutgers)
W70-06415

LEVY DISTRICTS (TAXATION).

Mo Ann Stat secs 245.175 thru 245.220 (1959).

Descriptors: *Missouri, *Levees, *Administrative agencies, *Taxes, Land reclamation, Land, Land tenure, Right-of-way, Surveys, Benefits, Damages, Assessments, Legislation, Construction, Costs, Maintenance, Compensation, Land appraisal, Legal aspects, Appraisals, Value, Government finance, Operating costs, Payment, Tax rate.
Identifiers: *Levee districts.

The board of supervisors of any levee district shall levy a uniform tax to pay all expenses incurred in the organization of such district. Maximum assessments are provided. Where districts are extended, new lands shall be subject to this tax. If the district dissolves, surplus money shall be refunded to landowners. Boards shall levy a total tax for costs of improvements in proportion to the benefits accruing to each landowner. Such total tax shall be paid through the levy of an annual installment tax. Procedures to be followed in the collection of the tax are outlined. Boards may levy additional taxes where additional improvements are required and may levy a mintenance tax to preserve improvements, but lands not protected by such improvements are not subject to this tax. Procedures are provided for readjustment of tax assessments where values in property change. Procedures are also outlined for the collection of delinquent taxes and civil penalties provided for deliquency. Tax levies shall constitute liens upon the land taxed. (Duss-Florida)
W70-06426

EFFECTS OF METERING URBAN WATER,
Colorado Univ., Boulder. Water Resources Program.
Steve H. Hanke, and J. Ernest Flack.
Journal American Water Works Association, Vol 60, No 12, p 1359-1366, Dec 1968. 8 p, 2 tab, 4 ref.

Descriptors: *Water rates, *Water demand, *Equipment, Water supply, Municipal water.
Identifiers: *Flat rates.

Under a flat rate system, consumers use as much water as they desire without incurring additional costs. Therefore, waste will occur since satisfaction will be optimized when the last unit of water consumed yields incremental benefits are close to zero. The metering of water represents an increase in the incremental money price from zero to some positive level, so that greater efficiency in the use of water supplies will result. Price-demand relationship may predict the effect of a price increase on total revenue through use of price elasticity of demand. Also, price is important as a control mechanism for the water supplier. Several studies are examined as to the effect of flat rates and water metering on the demand for water. The supplier can evaluate his alternatives (metering alone, increasing supplies, and a combination of both) in view of the effect of price increase on total revenues and water usage. (Grossman-Rutgers)
W70-06449

EVALUATION OF EFFICIENCY IN ALLOCATING CONTRACT RESEARCH FUNDS BY THE COLORADO WATER CONSERVATION BOARD,
Colorado State Univ., Fort Collins. Dept. of Economics.
David R. Allardice, and Kenneth C. Nobe.
Available from the Clearinghouse as PB-191 718, $3.00 in paper copy, $0.65 in microfiche. Colo State U, Economics Dept, Report No NRE-1, Dec 1968. 74 p, 6 fig, 17 tab, 1 append. OWRR Project A.005 - Colo (10).

Descriptors: *Grants, *Expenditures, Induced benefits, Contracts, Irrigation, Supply, *Cost benefit analysis.
Identifiers: *Colorado Water Conservation Board.

The major problems of managing and developing Colorado's water resources stem from unequal geographic distribution of supplies and users. The primary demand for water in Colorado has been for irrigation. The evaluation of research contracts includes an overall analysis of the Colorado Water Conservation Board's expenditures, a review of the individual contracts, an analysis of the contract procedure and an attempt to specify the nature of public benefits derived from these contracts. The history of the Board is also included. (Grossman-Rutgers)
W70-06452

EXPERIENCE WITH A WAGE INCENTIVE BONUS SCHEME AT GOSCOTE AND BROCKHURST SEWAGE WORKS,
B. R. Edmondson.
Water Pollution Control, Vol 68, No 4, p 437-442, July-Aug 1969. 1 fig, 2 tab, 2 ref.

Descriptors: *Waste water treatment, *Sewage treatment, *Working conditions, *Salaries, *Operation and Maintenance, Annual costs, Personnel, Performance, Income, Incremental income.
Identifiers: Time-work study, Bonus, Incentives, Performance.

A time-work study covering all the routine operations of two sewage treatment works was carried out. Based on an adjusted observed time of performance, each job was given a 'basic time' required for job completion. The total time allowed included rest allowances, special allowances, and seasonal allowances. A performance factor was devised relating allowed time to actual time. For every performance point over 100, the worker is paid a bonus as an incentive to better work. Difficulties arose in that if the work quality fell off, the bonuses were not paid, and the men could not understand why their paychecks decreased. Job values must be maintained at a fair rate to both management and labor. Labor unions recommended that all local authorities introduce incentive bonus schemes based on genuine work measurement techniques and having regard to the code of guiding principles, which recommends a bonus of 33 1/3% of basic pay rate for a standard performance. (Makela-Texas)
W70-06595

6D. Water Demand

WATER SUPPLY ECONOMICS IN THE POTOMAC RIVER BASIN,
Resources for the Future, Inc., Washington, D.C.
Robert K. Davis.
American Water Works Association Journal, Vol 56, No 3, p 257-266, March 1964. 10 p, 2 fig, 11 ref.

Descriptors: *Water quality, *Planning, *Water supply, *Economic efficiency, *Costs, Recreation, Benefits, Dissolved oxygen, Pollution, Water storage, Flow control, Capital, Operating costs, Waste treatment.
Identifiers: *Potomac River Basin, *Corps of Engineers, *Capital intensive system, *Operating cost system.

Planners must devise the best combination of quantity and quality control measures in view of growing and conflicting demands. Although withdrawal use of water will increase by large amounts in the next fifty years it is the greatly increasing waste load which poses the greatest problem. In the Potomac estuary the author gives two kinds of solution to pollution problems: increase waste assimilation capacity or reduce the amount of waste discharged. The costs involved in each method are studied for the purpose of applying cost-benefit analysis to the problem. The author discusses the economic problem of determining whether there is some combination of fixed and varying system capacity which is more efficient than either a system with a virtually fixed capacity or one with an almost completely varying capacity. Thus, the present value of such an investment, the distribution of low flows, the efficiency of each and the quality objectives are discussed and evaluated in this article. (Murphy-Rutgers)
W70-06437

AUSTRALIAN AND AMERICAN WATER ALLOCATION SYSTEMS COMPARED,
Peter N. Davis.
Boston College Industrial and Commercial Law Review, Vol 9, No 3, p 647-710, Spring 1968. 57 p, 343 ref.

Descriptors: *Foreign countries, *Water demand, *Water allocation (Policy), *Preferences (Water rights), Water law, Surface waters, Riparian rights, Mill dams, Reasonable use, Riparian land, Competing uses, Domestic water, Relative rights, Prescriptive rights, Eminent domain, Groundwater, Public rights, Navigation, Legal aspects, Legislation, Prior appropriation, Geographical regions, Priorities, Beneficial use, Permits.
Identifiers: *Australia.

Four water-use doctrines are examined: riparianism, prior appropriation, temporal non-priority permit systems, and market place concepts. The strengths and weaknesses of each are compared in light of 5 criteria: (1) security of the water right for investment purposes; (2) efficiency of water use; (3) flexibility in the allocative process to allow for economic growth, changing technology and changing demands; (4) protection of the public interest and preservation of watercourse amenities; and (5) the allowance of scope for private initiative. The Australian system for licensing private diversions is examined as an example of a temporal non-priority permit system. An analysis of alternative doctrines for water allocation in the United States is made with a view to selecting the one most suitable for allocating water in the eastern United States. (Cuevas-Florida)
W70-06467

OPTIMAL DISTRIBUTION OF WATER RESOURCES BETWEEN WATER USERS AND WATER CONSUMERS,
M. P. Fel'dman, A. L. Velikanov, and A. G. Kudinov.

Trans from Gidroteknicheskoe Stroitel'stvo, No 4, April 1969, p 25-28. Hydrotech Constr, No 4, ASCE, p 330-334, April 1960. 5 p, 6 ref.

Descriptors: *Optimization, *Water distribution (Applied), *Planning, *Multiple-purpose projects, *Dynamic programming, Water resources development, Water shortage, Mathematical models, Physicial properties, Resource allocation, Water users.
Identifiers: Consumers.

The problem of optimal utilization of water resources in the Soviet Union was discussed. The objective of the study was to formulate a technique for planning multipurpose water projects. The solution to this problem was preceded by an examination of (a) criteria of general effectiveness, (b) systems of initial information, including the economic and physical characteristics of water resources and the activity of the individual consumer under normal conditions of water shortage, and (c) selection of the mathematical model and algorithm for its solution. Dynamic programming was recommended for the distribution of given resources to specified components at a calculated level. (Thiuri-Cornell)
W70-06689

6E. Water Law and Institutions

SUMMARY OF WATER QUALITY STANDARDS FOR THE INLAND AND COASTAL WATERS OF TEXAS.
Federal Water Pollution Control Administration, Austin, Tex., and Texas Water Quality Board, Austin.
For primary bibliographic entry see Field 05G.
W70-06357

UNITED STATES V 222.0 ACRES OF LAND (PROPOSED BRIDGE CONSTRUCTION).

306 F Supp 138-156 (D Md 1969).

Descriptors: *Maryland, *Bridge construction, *Abutments, *Accretion (Legal aspects), Judicial decisions, Boundaries (Property), Navigable waters, Road construction, Access routes, Land reclamation, Land development, Federal government, State governments, Legislation, Regulation, Riparian rights, Riparian water, Land tenure, Bridges, Condemnation.
Identifiers: *Causeways.

A realty company and a bridge corporation entered into a complex transaction of land deeds involving reverter provisions for noncompliance with stipulated conditions. The land was given to the bridge corporation on condition that it would get the necessary permission, procure sufficient financing and attempt to build a bridge which would connect the mainland to an island on which the realty company owned other lands. The lands would thus be enhanced in value. The corporation procured partial financing for the bridge with the realty company's assistance. Lots on filled land which the realty company knew were encumbered by reverter provisions but which they did not relate to the purchasers were sold to raise funds. The bridge was not completed. The United States district court in Maryland, in a condemnation proceeding brought by the United States, found the realty company estopped to claim ownership in those lots sold with their assistance and with knowledge of the reverter provisions. Alluvion, accretion, and reliction in navigable waters are defined, and the effect of riparian ownership on lands so created is examined in light of Maryland Law. The court concluded that the bridge company's filled land was an integral part of the proposed bridge and was considered an 'improvement' within the meaning of a Maryland statute vesting ownership in the bridge company. (Barnett-Florida)
W70-06419

LEGAL LIABILITY AND LIMITATIONS WHEN PRIVATE PROPERTY IN COLORADO IS USED FOR OUTDOOR RECREATION,
Colorado State Univ., Fort Collins. Dept. of Economics.
George E. Radosevich, and Kenneth C. Nobe.
Available from the Clearinghouse as PB-191 717, $3.00 in paper copy, $0.65 in microfiche. Colorado State University, Dept. of Economics, Report No NRE-3, April 1969. 43 p, 3 append, 111 ref. OWRR Project A.005-Colo (9).

Descriptors: *Legal aspects, *Recreation, Recreation facilities.
Identifiers: Private property, Colorado Landowner Liability Act.

Colorado law, court cases, and regulations that deal with farmers, ranchers, and recreationists, are summarized. The following legal aspects are covered: Categories of real property and rights; Right of the possessor or property to exclude persons from the premises; Liability of owners and possessors of land for injuries and damage to other properties; User's liability for injuries and damages caused by the user, including easement owners having rights in the land; Owner or possessor's vicarious liability; Bailor liability; Product liability of seller; Liability of the state to land owners for activities of wild animals; and, Methods of limiting liability. (Grossman-Rutgers)
W70-06451

AUSTRALIAN AND AMERICAN WATER ALLOCATION SYSTEMS COMPARED,
For primary bibliographic entry see Field 06D.
W70-06467

SOVEREIGNTY SUBMERGED AND TIDAL LANDS IN COASTAL AND INTRACOASTAL WATERS.

Fla Admin Code, ch 200-2, 1968.

Descriptors: *Florida, *Water rights, *Dredging, *Ownership of beds, Bulkheads, Bulkhead line, Permits, State jurisdiction, Water resources development, Legislation, State governments, Accretion (Legal aspects), Boundaries (Property), Bank erosion, Avulsion, Docks, Piers, Jetties, Coastal structures, Retaining walls, Navigation, Conservation, Ecology, Environmental effects, Riparian rights, Navigable waters, Administrative agencies, Regulation.

Sovereignty , submerged and title lands shall include islands, sandbars, shallow banks, spoil islands and such areas of the bottom lands of meandered fresh water connected with or flowing into coastal and intracoastal navigable waters as are subject to ebb and flow of daily normal tides. In establishing bulkhead lines Trustees of the Internal Improvement Fund and local political subdivisions shall consider aspects of navigation, transportation, recreation, conservation, erosion control and problems of the immediate area. No dredging and filling of sovereignty lands may be undertaken without a permit issued by the local governing body and approved by the Trustees. Dredging of sovereignty lands to fill submerged lands must be limited to areas riparian to or directly seaward from the area to be filled. Any dredging project in the sovereignty waters is required to have a permit from the state. Dredging to improve navigation must not exceed requirements of normal boating. Biological survey reports may be required before any permit is issued. Rights-of-way may be granted in recognition of the servitude in favor of commerce and navigation. Permits are required for piers, wharves and docking facilities. The requirements for the approval of these projects are set forth. (Hubener-Florida)
W70-06470

PROBLEMS OF FEDERAL AND STATE RELATIONSHIPS IN THE FIELD OF WATER LAW,
Stanley Mosk.
ABA Sec of Mineral and Natural Resources Law (1962 Proceedings), p 120-124, 1962. 5 p.

Descriptors: *Federal-state water rights conflicts, *Water rights, *Prior appropriation, *State jurisdiction, Water law, Federal government, State governments, Legislation, Judicial decisions, Federal jurisdiction, Political aspects, United States, Legal aspects, Public lands, Appropriation, Preferences (Water rights), Riparian rights, Relative rights, Watersheds (Basins), Federal Power Act, Jurisdiction.

In case and statutory law, the federal government has protected the doctrine of prior appropriation in the West. The only inhibitions have been where the United States itself asserts a water right, and those have been generally in accordance with state law. However, a 1955 decision allowed the Federal Power Commission to build a dam across a nonnavigable river on federal lands not a part of the public domain. This raised a fear that the federal government could claim ownership of all unappropriated waters in the West, since most watersheds are national forests. Federal legislation has not been able to relieve this apprehension. Congress has not been able to deal with western water law because it has not been able to establish which rights have vested under state laws. Federal law must defer to state law. Complex problems require specialized, practical, local solutions. The federal government too often sticks to principles that make no sense at all because the individuals involved do not have the practical knowledge that local problems demand. (Douberley-Florida)
W70-06471

FISH AND GAME REFUGES.
Conn Gen Stat Ann secs 26-99 thru 26-107 (1960), as amended, (Supp 1969).

Descriptors: *Connecticut, *Fish management, *Fish conservation, *Wildlife conservation, Legislation, Administration, Administrative agencies, Boundaries (Property), State governments, Aquatic environment, Fish hatcheries, Fish, Lakes, Legal aspects, Public rights, Regulation, Trapping, Hunting, Rivers, Islands, Tidal waters, Water fowl, Harbors.

The State Board of Fisheries may establish state fish and game refuges. The Board may lease any land or lake or accept gifts of land or income to help propagate and preserve fish and game in this state. Such lands may be posted warning unauthorized persons not to enter. Wildlife refuges on private and public land can be closed to hunting, trapping, and fishing. The Board may establish fish spawning areas on any waters. It shall have emergency authority to declare a closed season on any fish species if the species is threatened with undue depletion. If such depletion is caused by any commercial fishing activity, the Board may regulate such activity and suspend such rights as they deem necessary. No person shall hunt, trap, fish, or destroy any wildlife or permit his dog to enter certain specified refuges. Penalties for violation of this act are provided. (Barnett-Florida)
W70-06473

WATER AUTHORITIES (POWERS OF LOCAL WATER AUTHORITIES).
Ill Ann Stat ch 111 2/3, secs 223-250 (Smith-Hurd 1966), as amended, (Supp 1970).

Descriptors: *Illinois, *Administrative agencies, *Water resources development, *Water management (Applied), Permits, Legislation, Regulation, Public health, Water pollution, Water allocation (Policy), Water supply, Well regulations, Well permits, Boating regulations, Fishing, Sewage, Docks, Water quality, Swimming, Recreation facilities, Reservoir operation, Easements, Financing.

Water authorities may be organized at the county level upon petition of at least 500 voters. Such authorities are empowered to: (1) inspect, regulate

and register wells; (2) establish priorities and otherwise regulate water use; (3) license and regulate water craft; (4) approve construction of docks; (5) establish recreational areas, parks, and access roads; (6) acquire an area for a reservoir and police such area; (7) grant easements; (8) sell or dispose of real or personal property; (9) protect public health; (10) operate a water distribution and sewage system; (11) abate pollution of water sources; (12) enforce ordinances and laws necessary to its functions; and (13) regulate fishing, boating and swimming. The authority may also issue bonds to finance construction and acquisition of property. Revenue derived from supplying water may be used to pay the interest on bonds and the cost of operation of the waterworks. (Hubener-Florida)
W70-06475

WATER RESOURCES ACTIVITIES IN THE UNITED STATES (POPULATION PROJECTIONS AND ECONOMIC ASSUMPTIONS).
Select Committee on National Water Resources (U.S. Senate), Washington, D.C.

Senate Comm on National Water Resources, Population Projections and Economic Assumptions, S Res 48, 86th Cong, 2d Sess (1960).

Descriptors: *Population, *Water resources development, *Water requirements, *Future planning (Projected), Estimating, Economic efficiency, Governments, Non-structural alterations, Research and development, Water allocation (Policy), Legislation, Federal government, Water resources planning, Analytical techniques, Methodology, Cities, Charts, Statistical methods, Census, Data collections, Measurement, Statistics.

The select committee on National Water Resources, charged with studying water requirements for the population, agriculture and industry of the United States between 1960 and 1980, found it necessary to develop projections of population and economic growth. Details as to the means, methods and procedures of compiling this data and the results of such analysis are found herein. Part one is the staff report dealing with population projections and economic assumptions. Part two consists of the report of the Census Bureau with its population projections. Part three consists of an analysis of the differences between the two sets of projections and a discussion of alternative ways of making projections for standard metropolitan areas in the future. Future population projections for the United States range from 225 to 278 million in 1980, and from 267 to 431 million in the year 2000. The gross national product in 1960 was approximately $500 billion. This should reach between $960 and $1,260 billion in 1980. Numerous graphs, charts and tables are included. (Barnett-Florida)
W70-06476

LEGAL ASPECTS OF LAKE DIVERSION (DIVERSION FROM LAKE MICHIGAN, AND DISPOSAL OF SEWAGE INTO THE MISSISSIPPI WATERSHED, BY CHICAGO),
Antony A. Olis, and Robert A. Sprecher.
Northwestern University Law Review, Vol 51, No 6, p 653-674, Feb 1957, 22 p, 110 ref.

Descriptors: *Diversion, *Lake Michigan, *Sewage disposal, *Watersheds (Basins), Legal aspects, Lakes, Municipal wastes, Canals, Water utilization, Withdrawal, Federal government, Judicial decisions, Navigation, Drawdown, Water allocation (Policy), Low-flow augmentation, Institutional constraints, Treaties, Legislation, Consumptive use, Cities, Jurisdiction, Transportation, Water supply, Mississippi River Basin.

Because of its need for a large supply of uncontaminated water, Chicago takes its water from Lake Michigan and by an extensive canal system disposes of its wastes into the Mississippi watershed. This practice has aroused protests of water level drawdown and increased wastes from both the Great Lakes states and Canada. Efforts to increase the amounts of diversion of water from Lake Michigan have met with much opposition, and have led to extensive litigation since the early 1900's. The canal system between Chicago and the Mississippi serves both for sewage disposal and as a means for water transportation between the Great Lakes and the Mississippi Basin and the Gulf. The need for improved transportation is probably a more convincing argument for increased diversion from the lake than sewage disposal needs. Even though the United States Supreme Court has retained jurisdiction over the issue, Congress' dominion over navigable inland waterways gives it the power to regulate the diversion of lake water by statute. Treaty obligations with Canada do not prevent an increase in lake diversion, it is argued, and such increase is likely. (Caldwell-Florida)
W70-06477

A COMPARISON OF OIL AND GAS LEASING AUTHORITIES IN THE GULF OF MEXICO (STATES OF ALABAMA, MISSISSIPPI AND LOUISIANA AND THE FEDERAL GOVERNMENT) AND THE JURISDICTIONAL CONFLICT OVER THE BOUNDARY BETWEEN STATE AND FEDERAL AUTHORITY IN THE GULF OF MEXICO,
Jean R. Richey.
Mississippi Law Journal, Vol 40, No 3, p 351-392, May 1969. 42 p, 156 ref.

Descriptors: *Submerged Lands Act, *Gulf of Mexico, *Boundary disputes, *Leases, Mississippi, Alabama, Louisiana, Legislation, Planning, Administration, Administrative agencies, Contracts, Riparian rights, Littoral, Tidal waters, Continental shelf, Boundaries (Property), High water mark, Low water mark, Shores, Legal aspects, Judicial decisions, Equitable apportionment, Negotiations, Water rights, Oil industry, Natural gas, Exploitation, Oil fields, Exploration, Federal government.

The leasing of lands in the Gulf of Mexico for oil, gas, and mineral exploration is controlled by the federal government and agencies of the states of Alabama, Mississippi and Louisiana. The legislative basis for the jurisdiction to lease such lands is found in the 'Submerged Lands Act' and the 'Outer Continental Shelf Lands Act.' The provisions of these acts are examined. The composition and function of the states' regulatory agencies is contrasted with the powers of the federal government under the enabling legislation. The procedures, regulations, powers and functions of each state agency are examined as well as each state's statutory enactments relating to such leasing. Because of uncertainty as to the exact location of the boundary line between federal and state areas under the Submerged Land Act, conflicts have arisen between state and federal leasing authorities. The states' arguments are presented, and examples of litigation between the federal and state agencies are discussed. Suggested means of resolving the conflict are presented, one of which is recourse to Congress for clarifying legislation to establish a division of authority between state and federal agencies. (Barnett-Florida)
W70-06478

A REPLY TO MR. FINLAY (EXCLUSIVE MINERAL RIGHTS IN THE CONTINENTAL SHELF),
Louis Henkin.
American Journal of International Law, Vol 64, No 1, p 62-72, Jan 1970. 11 p, 19 ref.

Descriptors: *Ownership of beds, *Continental shelf, *Marine geology, *Structural geology, Beds under water, Beds, Regions, continental margin, Oceans, Coasts, Mineralogy, Legal aspects, International law, Oil industry, International waters, Jurisdiction, Judicial decisions.

The National Petroleum Council and Mr. Finlay, a petroleum industry spokesman, take the position that the continental shelf includes those seabeds which are potentially exploitable; therefore, the coastal states can claim exclusive mineral rights in such areas. This contention is neither supported by the Articles of the Convention of the Continental Shelf nor by legislative history. The coastal state cannot claim adjacent seabed in the continental shelf until it becomes actually exploitable. Mr. Finlay also contends that the legal shelf for exclusive mineral rights includes the entire submerged continental mass down to the deep ocean basin. The correct interpretation is that only so much of the submerged land mass adjacent, near, or within some maximum distance from the coast can be claimed as continental shelf. Mr. Finlay relied on the legislative history of the Convention, the Cuidad Trujillo Resolution and the North Sea Cases to support the view that 'adjacent' means all the submerged land mass regardless of proximity to the coast. Deliberations of the International Law Commission which drafted the Convention's Articles do no support Mr. Finlay. In fact, the Commission's final report adopted, to a certain extent, the geographical test for the continental shelf. Furthermore, the Trujillo Resolution was not incorporated into the Convention's articles, and the International Court of Justice cases do not support the contentions of the Council and Mr. Finlay. (Powell-Florida)
W70-06479

THE UNITED NATIONS AND THE BED OF THE SEA,
Clark M. Eichelberger.
San Diego Law Review, Vol 6, No 3, p 339-353, July 1969. 15 p, 19 ref.

Descriptors: *International waters, *Continental shelf, *Exploitation, *Ownership of beds, United Nations, International law, International commissions, Legal aspects, Exploration, Oceanography, Resource development, Sea water, Natural resources, Conservation, Water pollution, Technology, Mineralogy, Economics, Economic impact, Military aspects, Treaties, Navigation, Regulation, Coasts, Drilling, Oil, Beds under water, Water pollution control.

The seabeds should be reserved from national claims of sovereignty and their use limited to peaceful purposes. All nations should have access to seabeds for exploration and exploitation. An authority of the United Nations should be created to control such access. Economically, seabeds are of great importance, and advancing technology requires the establishment of an international regime. Today there are many difficulties concerning jurisdiction over the ocean floor. Much of the trouble is derived from ambiguous wording in the 1958 Convention on the Continental Shelf. The Convention has left open the possibility of nations claiming exclusive sovereignty over seabeds beyond points where water depth exceeds 200 meters. The United Nations General Assembly has responded to these problems in several ways including: (1) creation of a committee to study legal aspects which would promote international cooperation and control; (2) studies for marine pollution control; and (3) efforts to formulate an international control authority. Unfortunately, there have been many areas of disagreement among the nations. These include: (1) the area of the seabeds to be controlled; (2) the meaning of restrictions to peaceful purposes; and (3) the form of the legal authority to govern seabeds. The Commission to Study the Organization of Peace has submitted a set of principles that should be adopted regarding access to and development of seabeds. These should be adopted as a step toward creation of an effective international regime. (Duss-Florida)
W70-06480

THE CONTINENTAL SHELF AND THE UNITED STATES,
J. Munford Scott, Jr.
South Carolina Law Review, Vol 22, No 1, p 34-49, 1970. 15 p, 43 ref.

Descriptors: *Continental shelf, *United States, *International law, *Law of the sea, Oceans, International waters, Treaties, Legal aspects, Sea water, International commissions, Navigation, Littoral, Judicial decisions, Continental slope, Legislation, Submerged Lands Act, Federal government, Continental margin, Structures, Jurisdiction, Political aspects, Islands, Construction, Public rights, Relative rights.

Control of the continental shelf has been a historic concern of nations, culminating in many divergent attempts by nations in the last 30 years to establish jurisdiction over contiguous continental margins. Two theories of ocean floor ownership exist: (1) res communis--that it belongs to all nations equally and cannot be controlled exclusively by any one state, and (2) res nullius--that it belongs to no state and is capable of acquisition by effective control. The Geneva Convention on the Continental Shelf was drafted to apply international law to these divergent viewpoints, and provided that a nation could claim the shelf to a depth of 200 meters. The Convention further provided that this control was in the nature of a sovereign right for the purpose of exploration and exploitation, thus leaving undisturbed traditional rights of navigation in the above waters. The United States has passed several laws concerning the continental shelf, including the Submerged Lands Act, which assert national jurisdiction over the shelf and provide for the exploitation of its resources. It was not specifically provided, however, that jurisdiction extends to artificial structures not for exploration or exploitation which were on the shelf but outside the three mile limit. A recent case illustrated this; it involved an attempt by private developers to build an island which in effect would have been a new sovereign nation, on the shelf. The island was held to constitute an obstruction to navigation and subject to prohibition by federal law. (Caldwell-Florida)
W70-06481

RECENT DEVELOPMENTS CONCERNING THE EXPLORATION AND EXPLOITATION OF THE OCEAN FLOOR,
Allan E. Gotlieb.
McGill Law Journal, Vol 15, No 2, p 260-278, June 1969. 19 p, 28 ref.

Descriptors: *Oceans, *Continental shelf, *Conservation, *Law of the sea, Marine fisheries, Sea water, Natural resources, Legal aspects, Marine geology, International law, Public rights, Federal government, Legislation, Negotiations, Project planning, Regulation, Water rights, Water resources development, Administration, Administrative agencies, Navigation, Fishing, Mineralogy, Continental slope, Exploration, Exploitation, International waters, State governments, State jurisdiction.

The seas and their natural resources are of immense value to man. A basic lack of interest in this resource has been replaced by a deep concern for the conservation, exploration and exploitation of the ocean floor. This interest has been spurred by the realization that the rapidly diminishing resources are not inexhaustible and that national and international efforts in the fields of research, management and conservation are necessary. The basic question approached herein is: What is the present status of international law with regard to the rights of states to exploit the resources of the sea-bed. Article 1 of the Convention on the Continental Shelf is examined in great detail, while superficial treatment is given to the balance of the Convention. Other related legal aspects to freedom on the high seas for travel and exploration are discussed. Theoretical legal possibilities, termed by the author alternative regimes, are proposed as a means of internationally controlling the exploitation and exploration of this vital natural resource. (See also W70-06483 thru W70-06484). (Barnett-Florida)
W70-06482

RECENT DEVELOPMENTS CONCERNING EXPLORATION AND EXPLOITATION OF THE OCEAN FLOOR (INTRODUCTION AND DISCUSSION OF THE PRESENT LAW),
Allan E. Gotlieb.
McGill Law Journal, Vol 15, No 2, p 260-270, June 1969. 11 p, 24 ref.

Descriptors: *Continental shelf, *Continental slope, *Oceans, *Marine geology, Structural geology, Administration, Legal aspects, Law of the sea, Internation law, Regulation, Federal government, Mineralogy, Ownership of beds, Beds under water.

In 1958, the Geneva Convention on the Continental Shelf had the most significant effect on settling the subject of international property rights of the ocean's floors. In Article 1 of the Convention, concern was limited to the continental shelf, that area which the Convention felt was significantly affected by international exploration and exploitation. The continental shelf is: (1) the seabed and its subsoil; (2) adjacent to the coast; (3) where the territorial sea ends; and (4) limited to a depth of 200 meters. These four main elements of the definition of the continental shelf are examined. It is suggested that this definition may create problems of interpretation in that it takes little account of the geographical-geophysical realities of the oceanic submerged areas. The other articles are examined to better grasp the underlying principles of the Convention. The question of sovereign rights is cited as extremely confused but vital. It is felt that the Convention is not fully satisfactory in that it was handicapped by a lack of technical information. However, it does embody essential rules which are extremely vital. (See W70-06482). (Barnett-Florida)
W70-06483

RECENT DEVELOPMENTS CONCERNING THE EXPLORATION AND EXPLOITATION OF THE OCEAN FLOOR (ALTERNATIVE LEGAL POSSIBILITIES),
Allan E. Gotlieb.
McGill Law Journal, Vol 15, No 2, p 270-279, June 1969. 9 p, 4 ref.

Descriptors: *Oceans, *Law of the sea, *International law, *Conservation, Regulation, Legal aspects, Governments, Foreign countries, Planning, Legislation, Political aspects, Natural resources, Water resources development, Jurisdiction, Federal jurisdiction, Ownership of beds, Beds under water, State jurisdiction.

The Convention on the Continental Shelf has caused an outcry for a new definition of the limits of national jurisdiction on the ocean floor. Some alternatives to achieve this end are discussed and discarded by the author. The alternatives discarded are: (1) a division of the seabed and ocean floor by agreement amongst all nations; (2) coastal states extending their jurisdiction as far as technology permits up to the median line in accord with the Convention; (3) declaring beds beyond defined limits of seabed as res nullium and susceptible of occupation; (4) control analogous to that used in the exploration of outer space; and (5) some form of international control. All of these alternatives are deemed unfeasible. The only method of adequate control is the establishment of a new legal system, with new legal rules which would establish that the resources of the deep ocean floor can be developed and used for the benefit of mankind as a whole. The current position of the law and future prospects are examined in light of projected needs. (See W70-06482). (Barnett-Florida)
W70-06484

LEVEE DISTRICTS (BOARD OF SUPERVISORS AND BOARD OF COMMISSIONERS).
Mo Ann Stat secs 245.095 thru 245.135 (1959).

Descriptors: *Missouri, *Administrative agencies, *Water management (Applied), *Land reclamation, Rivers, Streams, Channels, Levees, Flow, Overflow, Drainage engineering, Ditches, Sewers, Pumping plants, Embankments, Dikes, Sluices, Right-of-way, Condemnation, Easements, Benefits, Damages, Planning, Legislation, Judicial decisions, Diversion.
Identifiers: *Levee districts.

In order to effect the leveeing, protection, and reclamation of land and other property in levee districts, the Board of Supervisors has authority to construct necessary improvements upon levees and waters within such districts. This includes the construction of such improvements as dikes, dams, ditches, and pumping stations. The power of the Board extends to condemnation of land. The Board shall appoint a chief engineer and approve necessary assistants to direct the engineering work in the district. The chief engineer shall submit a plan to the Board for the leveeing, reclaiming, or protection of district lands. The Board shall pass upon the plan. The secretary of the Board shall file the plan with the circuit court; and the Board shall petition the court to appoint commissioners to appraise the lands to be acquired for rights-of-way. The Board of Commissioners appointed shall inspect the lands, assess the benefits and damages and then file a report with the court. Property owners shall receive notice of the report and may file exceptions to it. The circuit court shall rule on the report. The court shall dissolve the district if projected costs of improvements exceed benefits. (Duss-Florida)
W70-06487

THIRD CLASS CITIES (ACQUISITION OF SEWER ROUTES).

Mo Ann Stat secs 88.563 thru 88.590 (1952).

Descriptors: *Missouri, *Cities, *Sewers, *Drainage systems, Legislation, Legal aspects, Conveyance structures, Sewage districts, Community development, Watercourses (Legal), Drains, Public utilities, Condemnation, Construction, Maintenance, Right-of-way, Cost allocation, Local governments, Construction costs, Assessments.

Whenever a third class city proposes to make use of any natural course of drainage or watercourse as a public drain or sewer route or land for the erection and maintenance of disposal plants, the acting municipal authorities, by ordinance, shall declare the same to be a public drain and sewer route. The ordinance declares what sewer districts are benefited by the use of the natural watercourse as a public drain or sewer route. The use of any watercourse can be acquired by gift, purchase or condemnation. Any part of the requisite right-of-way for any sewer through private property is acquired by condemnation. The cost of acquiring the use of a watercourse is collected by special tax from the territory benefited by such acquisition. Provisions regulate the assessment of damages resulting from the acquisition or appropriation of the watercourse. The appointment of commissioners to assess damages is regulated. The sewer acquisitions and appropriation costs, including the cost of acquiring land for the erection and maintenance of disposal plants, constitute a lien on all the lands within the district, exclusive of public highways, streets, and alleys. (Powell-Florida)
W70-06488

MARLATT V PEORIA WATER WORKS (SCOPE OF PUBLIC UTILITY'S EASEMENT),
252 NE2d 403-410 (3d Dist Ill 1969)

Descriptors: *Illinois, *Easements, *Public utilities, *Usufructuary right, Judicial decisions, Water distribution (Applied), Facilities, Utilities, Legal aspects, Local governments, Real property, Land, Land use, Pipes, Pipelines, Conduits, Water supply.

Plaintiff acquired property burdened by an easement for the use of public utilities to install and maintain gas pipes, conduits, cables, poles, and wires for the purpose of serving adjoining property with gas, electric, and telephone service. A water

main was constructed by defendant extending partially below the surface of plaintiff's lot. Water service for plaintiff's house was not provided by use of the main beneath his lot. Plaintiff brought an action in trespass and ejectment. THE LOWER COURT HELD FOR PLAINTIFF. Defendant appealed, basing his argument on the reservation of an easement for public utilities service. This court affirmed, holding that easement created by reservations in a deed is limited to the scope and purpose of the easement as specifically delineated on the recorded plat. The reservations in question made no mention of water pipes and the burden of the easement on plaintiff could not be extended by implication. If the reservation was in favor of public utilities generally such a right might be implied, but the additional specific language in the present easement precluded such interpretation. (Dye-Florida)
W70-06489

ROSE V FRANKLIN (TITLE TO LAND ABUTTING ON NON-NAVIGABLE STREAM AS RUNNING TO MIDDLE OF STREAM).
4 SE2d 876-877 (NC 1939).

Descriptors: *North Carolina, *Boundaries (Property), *Boundary disputes, *Non-navigable waters, Riparian rights, Riparian land, Ownership of beds, Land tenure, Streambeds, Riparian water, Streams, Rivers, Meanders, Surveys, Judicial decisions, Legal aspects, Mapping, Water law, Beds, Beds under water, Bench marks, Relative rights.

Plaintiffs held a deed to riparian land which specified that the boundary thereof ran to a certain point in the river and then 'down the meanders of the river.' Plaintiffs claimed that their title extended under this deed to the middle of the non-navigable river. Defendant claimed he had previously been granted the entire bed by the state. The court held that the description in the plaintiffs' deed made the river the boundary and that specifically the boundary was the middle of the non-navigable stream. Since defendant had previously admitted that plaintiffs had title to all lands within the boundaries described in the deed, the judgment for plaintiff in the ejectment action below was affirmed. (Caldwell-Florida)
W70-06492

KELLY V KING (EXTENSION OF RIPARIAN LAND BOUNDARY TO MIDDLE OF STREAM).
36 SE2d 220-225 (NC 1945).

Descriptors: *North Carolina, *Non-navigable waters, *Boundary disputes, *High water mark, Boundaries (Property), Marshes, Ownership of beds, Channels, Land tenure, Beds under water, Maps, Swamps, Surveys, Damages, Legal aspects, Judicial decisions, Riparian rights, Riparian land, Navigable streams, Beds, Water law, Legislation, Reclamation.

Plaintiffs owned land abutting on a sound, and their deeds either specified that the boundary was the high water mark of the sound or made reference to a recorded plat which showed the high water mark as boundary. The court found the sound, consisting of a marsh and a small channel, to be non-navigable, and held that while generally the title to riparian land on non-navigable waters extends to the middle of the waterway, the specific words in the deeds and the plat superseded this rule. Although the deeds of some plaintiffs specified boundaries other thn the high water mark, the court ruled that the plat was incorporated by reference into the deeds and was sufficient to overcome the conflicting descriptions in the deeds. (Caldwell-Florida)
W70-06493

EWELL V LAMBERT (THE TEST FOR NAVIGABILITY OF A STREAM).
13 SE2d 333-336 (Va 1941).

Descriptors: *Virginia, *Ownership of beds, *Riparian rights, *Non-navigable waters, Boundaries (Property), Judicial decisions, Legal aspects, Boundary disputes, Streams, Navigable waters, Riparian waters, Riparian land, Beds, Tidal waters, Administrative agencies, Beds under water, Relative rights, State governments, Jurisdiction.
Identifiers: *Non-tidal waters, *Oyster planting grounds.

Plaintiffs were the separate owners of real estate situated on a creek. The portion of the creek adjacent to their lands had always been a non-tidal and non-navigable body of water. Plaintiffs and their predecessors in title had always asserted their ownership of the creek and its beds in fee simple. The defendants, an oyster inspector and the Virginia Commission of Fisheries, advised the plaintiffs that the Commission had jurisdiction over the bed of such creek and that defendants had received and were considering an application for the assignment of a portion of the creek bed adjacent to plaintiffs' land as oyster planting grounds. Plaintiffs sought an injunction restraining the defendants from asserting jurisdiction over the described portion of the creek bed and from assigning such portion of the submerged lands as oyster grounds. The defendants contended that the said creek was both tidal and navigable. The appellate court affirmed the chancellor's decree granting a permanent injunction against defendants. The court stated that the question of navigability was one of fact. The test of navigability is whether the stream is being used or is susceptible of being used, in its natural and ordinary condition, as a highway for commerce, on which trade and travel are or may be conducted in the customary modes of trade and travel on water. The court also recognized the rule that a grant or conveyance of land bounded by a non-navigable stream carries with it title to the bed of the stream to its center, unless there is contrary intent in the deed. (Powell-Florida)
W70-06494

MUELLER V KLINHART (RIGHT TO USE PORTION OF ARTIFICIAL LAKE OVERLYING ANOTHER'S PROPERTY).

167 SW2d 670-671 (Ct App Mo 1943).

Descriptors: *Missouri, *Boundaries (Property), *Artificial watercourses, *Barriers, Lakes, Ownership of beds, Non-navigable waters, Relative rights, Riparian rights, Reasonable use, Easements, Riparian land, Bodies of water, Judicial decisions, Legal aspects, Lake beds, Recreation, Non-consumptive use, Public rights, Water law, Usufructuary right, Remedies, Land tenure.

Plaintiffs sought to enjoin defendants from maintaining barriers along the boundary lines of defendants' portion of the bed of an artificial non-navigable lake. The effect of these barriers was to prevent plaintiffs and their guests from using the waters over the beds belonging to the defendant. The court held that where plaintiffs' property was covered by the waters of an artificial lake created by the predecessor in title of both plaintiff and defendant, the plaintiff was entitled to the use of all of the lake waters. Such entitlement was said to be in the nature of an easement, the court stating that the plaintiff need not be a riparian owner of a navigable stream to qualify as the holder of such easement. Moreover, it was held unnecessary for the lake in question to be dedicated to public use. The lower court decree granting the injunction was affirmed. (Caldwell-Florida)
W70-06496

MEDLOCK V GALBREATH (OWNERSHIP OF BEDS OF NON-NAVIGABLE WATERS AS CONTROLLING RIGHT TO REGULATE FISHING IN THOSE WATERS).
187 SW2d 545-547 (Ark 1945).

Descriptors: *Arkansas, *Non-navigable waters, *Fishing, *Ownership of beds, Streambeds, Surface waters, Commercial fishing, Fish migration, Fish passage, Boundaries (Property), Navigable waters, Judicial decisions, Legal aspects, Beds, Beds under water, Bodies of water, Fish, Relative rights, Water rights, Land use, Reparian rights, Remedies.

Defendants, owners of a portion of the bed of a non-naviagable waterbody, appealed a decision enjoining them from interfering with the commercial fishing operations of plaintiffs in the waters over defendants' beds. The court concluded that owners of beds of non-navigable waters have a right to control that part of the surface of the water above their beds, even to the extent of fencing off their respective portions. However, defendants had not marked off their portion, and because the body of water had both inflowing and outflowing streams through which fish could freely migrate in either direction, defendants were held to have no ownership in the fish. The court therefore held that under these facts the plaintiffs had a right to conduct lawful fishing operations in the waters over defendants' beds and defendants could be enjoined from interfering with these operations. (Caldwell-Florida)
W70-06498

MERRITT V PALMER (BOUNDARY DISPUTE WHERE CREEK AND SWAMP FORMED BOUNDARIES).
158 SW2d 163-166 (Ky 1942).

Descriptors: *Kentucky, *Boundary disputes, *Boundaries (Property), *Watercourses (Legal), Meanders, Streams, Swamps, Maps, Mapping, Surveys, Judicial decisions, Legal aspects, Land tenure, Water levels, Channels, Channel flow, Bodies of water, Channel morphology.

A dispute arose over the location of the true boundary line between two farms. The creek forming the boundary line in places spread out and formed a swamp with no discernable channel. A survey was ordered by the court but was excepted to by the parties and was thrown out. The court held that where there was a conflict between the meanders of the stream and the description in the deed, the location of the stream prevails. The determination of the boundary in swampland areas, and whether the creek had a defined channel at a particular spot were for determination by the trial court and would not be disturbed. (Caldwell-Florida)
W70-06499

WATER FOWL ON SHARK RIVER PROTECTED; PENALTY.
NJSA sec 23:9-98 (1940).

Descriptors: *New Jersey, *Water fowl, *Hunting, *Birds, Aquatic life, Animals, Legislation, Legal aspects, Wildlife, Ducks (Wild), Animal groupings, Bird types, Game birds, Shore birds, Water birds, Rails.
Identifiers: Penalties (Criminal).

It is unlawful for any person, on the Shark River, to shoot, hunt, kill, destroy or injure any: (1) anatidae, commonly known as swans, geese, brant and river and sea ducks; (2) rallidae, commonly known as rails, gallinules, coots and mud hens; and (3) limicolae, commonly known as shore birds or surf or bay snipe. A penalty of twenty-five dollars per offense is provided. (Powell-Florida)
W70-06500

CITY OF PRINCETON V MARTIN (PROPERTY BOUNDARIES OF RIPARIAN LAND).

170 SW 2d 660-661 (Ky 1943).

Descriptors: *Kentucky, *Boundary disputes, *Boundaries (Property), *Riparian land, Riparian rights, Judicial decisions, Legal aspects, Banks, Streams, Navigable waters, Cities, Assessments, Watercourses (Legal), Beds, Channels.

The plaintiff municipality improved a city street and assessed the abutting property owners therefor. A creek bordered the street on the west and bor-

dered defendant's land on the east. The plaintiff city assessed the defendant's land which the plaintiff contended fronted on the west side of the street. Defendant contended that he owned only to the west bank of the creek by virtue of his predecessor's deed. Plaintiff brought suit to recover the unpaid balance of the special assessment for street improvement. The plaintiff contended that even if defendant's line ran to the thread of the creek, his property would still front on the street, because the stream constituted a part of the street. The appellate court, in affirming the trial court's judgement for defendant, held that where land is granted on a fresh water stream, the line extends to the thread of the main channel unless it is clear from the grant that the intention was otherwise. The court determined that the defendant's predecessors in title could not convey property beyond the center of such creek. The land was not subject to a special assessment for street improvements. (Powell-Florida)
W70-06501

BROWN V WILSON (ACCRETION INVOLVING A CHANGE OF STREAM FLOW--PROPERTY RIGHTS).
155 SW2d 176-180 (Mo 1941).

Descriptors: *Missouri, *Accretion (Legal aspects), *Boundaries (Property), *Boundary disputes, Ownership of beds, Streams, Rivers, Shores, Riparian rights, Costs, Streamflow, Alteration of flow, Legal aspects, Non-navigable waters, Islands, Judicial decisions, Marshes, Wetlands, Relative rights.
Identifiers: *Sloughs.

Plaintiff owned a tract of land bounded on the north by a non-navigable stream. Defendant owned an adjacent tract bounded on the south by the same stream. Warranty deeds to both tracts described the stream as the northern and southern boundaries respectively. A dispute arose concerning the ownership of a small portion of land lying between the main channel of the stream to the north and a slough to the south which had constituted the main channel until about thirty years before the litigation. The slough remained a distinct channel, and during times of high water a part of the river flowed through it. The evidence was unclear as to whether the stream had changed course suddenly or gradually, though there was substantial evidence showing that the tract in question once was a distinct island with water flowing through both channels. The issue was whether the disputed land accreted to the plaintiff. The court held that adjacent landowners whose property is divided by a non-navigable stream own to the center or thread of the stream, and where a subsequent change in the course of the stream occurs through the gradual process of accretion, the boundary line changes with the stream. But when the stream changes course suddenly or in such a manner as not to destroy the identity of the land between the two channels, the process is not one of accretion, and the boundary line is unchanged. The trial court's finding in favor of the latter situation was upheld. (Clarke-Florida)
W70-06502

BROWN V WILSON (OWNERSHIP OF LAND AFTER STREAM AVULSION).

131 SW2d 848-852 (St Louis Ct App Mo 1939).

Descriptors: *Missouri, *Boundaries (Property), *Accretion (Legal aspects), *Land tenure, Land farming, Land use, Legal aspects, Real property, Boundary disputes, Water law, Rivers, River flow, Judicial decisions, Avulsion, Relative rights.

A river bounds plaintiff's land on the north and defendant's land on the south. The river now flows in a channel farther north than previously. Plaintiff brought an action of ejectment, alleging that the change in course of the river was so gradual as to make the property to the south of its new course an accretion to plaintiff's land. Defendant claimed that the change in course of the river was sudden, and that the uncovered property had lost none of its distinction. Consequently, the property was not accreted to plaintiff's property. Furthermore, even if the property was an accretion defendant had acquired right to possession by adverse possession. The lower court refused to eject defendant and plaintiff appealed. At on point in the change in channels of the river the disputed property was a distinct island, tending to refute plaintiff's characterization of the land as accretion. Defendant had been in notorious possession of the property for a period greater than that necessary to obtain title by adverse possession. The court held there was ample evidence to allow the lower court to find for defendant on the basis of either of his claims. (Dye-Florida)
W70-06503

IRWIN SAVINGS AND TRUST CO V PENNSYLVANIA RY CO (DROWNING IN POND CREATED BY OBSTRUCTED CULVERT).
32 A2d 432-443 (Penn 1944).

Descriptors: *Pennsylvania, *Railroads, *Obstruction to flow, *Culverts, Damages, Judicial decisions, Bodies of water, Drains, Surface drainage, Watercourses, Embankments, Diversion, Structures, Standing waters, Ponds, Legal aspects, Drowning, Ice.

The defendant railroad failed to unstop a culvert under one of their embankments, and water backed up to form a pond. Four children fell through the ice and drowned. Plaintiff sought damages. The court first held that a pool backed up by defendant onto a third-party's land is not an attractive nuisance where there is no unusual danger. While the defendant was negligent in allowing the pond to form, such negligence was not the proximate cause of the drownings, since the drownings were not reasonably forseeable. The defendant was therefore not liable. The court further stated that any duty of the railroad not to allow water to back up onto another's land was owed to the owner of the land and did not run to the children. The dissenting opinion contended that a duty ran to the public to keep the culvert open and would have found defendant liable. (Caldwell-Florida)
W70-06504

GOFORTH V WILSON (RIPARIAN BOUNDARIES ON SHIFTING NON-NAVIGABLE STREAM).
184 SW2d 814-816 (Ark 1945).

Descriptors: *Boundaries (Property), *Avulsion, *Accretion (Legal aspects), *Boundary disputes, Riparian rights, Alteration of flow, Low water mark, Non-navigable waters, Legal aspects, Streams, Land tenure, Watercourses (Legal aspects), Channels, Riparian land, Rivers, Islands, Relative rights, Judicial decisions, Navigable waters.

The plaintiffs had inherited land with a non-navigable stream as a boundary line; they used defendants claiming that the non-navigable stream had changed course by an avulsion in 1943 and, as between them and the defendants, the main channel existing in 1938 rather than the present channel, remained the boundary. The court ruled that navigability of a stream is a question of fact and that riparian owners upon a non-navigable stream own to the center of the stream ratably with other owners. When a stream changes course by accretion, the boundaries change with the stream. When the stream shifts by avulsion, the boundaries do not change. The test is whether change is gradual or sudden. Plaintiffs had the burden of showing avulsion and had failed to do so. The boundary therefore remained the present center of stream. (Leesfield-Florida)
W70-06599

WARNER V CLARKE (RIGHT TO ENTER PRIVATE LAND ADJACENT TO NAVIGABLE WATERS).
232 So2d 99-103 (La App 1970).

Descriptors: *Louisiana, *Public rights, *Riparian rights, *Navigable waters, Legal aspects, Judicial decisions, Navigable rivers, Streams, Lakes, Bayous, Banks, Levees, Ponds, Fishing, Hunting, Channels, Mississippi River, Land, Land use, Land tenure, Remedies, Relative rights.
Identifiers: *Riparian servitude, Penalties (Criminal).

Plaintiffs, Louisiana residents, brought suit against the parish district attorney for a declaratory judgment declaring certain lands to be subject to public use. Plaintiffs desired to hunt and fish on lands which were owned by private persons. The lands were located along the Mississippi and contained navigable waters. Plaintiffs based their claim on a state law which gave the public the right to tie up vessels on the banks of navigable streams and rivers. The trial court ruled that plaintiffs did not have the right to enter upon these lands for hunting and fishing purposes. The court of appeals affirmed, noting that riparian servitudes are not subject to broad interpretation, but exist only for that which is incident to the nature and navigable character of streams flowing on proprietor's land. Thus the statute could not be construed to give plaintiffs the right to hunt and fish on private land. The court also noted that a declaratory judgment was an improper remedy since none of the landowners was made party to the suit. (Duss-Florida)
W70-06613

PARADA V UNITED STATES (RIPARIAN INJURY CAUSED BY NEGLIGENT OPERATION OF FEDERALLY OWNED CANAL).

420 F2d 493-495 (5th Cir 1970).

Descriptors: *Texas, *Federal government, *Gophers, *Irrigation, Operation and maintenance, Riparian rights, Check structures, Irrigation canals, Legal aspects, Judicial decisions, Riparian land, State governments, Water delivery, Flood control, Control structures, Diversion structures, Flood damage, Inspection, Flood protection, Overflow, Leakage, Canal seepage.

Plaintiff's land was damaged by water flowing from a break in an irrigation canal constructed and maintained by defendant Bureau of Reclamation of the United States Department of the Interior. The evidence showed that the break was caused by the burrowing of gophers, that defendant had the responsibility of maintaining the canals, and that defendant's agents had not inspected the area of the break during the four months prior to the break, although fully aware of the gopher problem. Plaintiff contended that defendant was negligent, and that its negligence was the proximate cause of plaintiff's injuries. Defendant claimed that the break was caused by the burrowing of gophers which was an act of God. The court held that defendant was derelict in its duty to maintain the canal. Defendant was fully aware of the gopher activity in the area; thus the sudden unforeseeable, catastrophic character of an act of God could not be attributed to the burrowing of the gophers. Defendant's failure to inspect the area was the proximate cause of the break, and it could have reasonably foreseen that such failure to inspect would lead to a break which would cause flood damage to neighboring lands. (Clarke-Florida)
W70-06654

BERO V STATE (PROCEEDING IN EMINENT DOMAIN TO ESTABLISH JUST COMPENSATION).
305 NYS2d 309-312 (1969).

Descriptors: *New York, *Eminent domain, *Gravels, *Appraisals, Highways, Drainage, Judicial decisions, State governments, Legislation,

Banks, Navigable rivers, Damages, Local governments, Easements, Ownership of beds, Road construction, Right-of-way, Negotiations, Legal aspects, Permits, Bank erosion, Administration, River beds, Roads, Roadbank.

The state under its power of eminent domain appropriated lands for the construction of an interstate highway. Due to the location of the condemned land, a 27.05 acre gravel area including a .272 acre drainage easement was diminished in value. The state conceded the entire land area including a .382 acre streambed under an adjacent river was rendered valueless. Claimant's and state's appraisal experts differed as to the value of the land. Appraisals were made on the basis of the sale of comparable lands located nearby. The state alleged that an erroneous award had been made based on a valuation of gravel-excavation land values for acreage under and on the banks of the adjacent river; the plaintiff was prohibited from utilizing such gravel except by special permit. The court held that claimant's failure to prove legal capacity to make use of the riverbed and bank for digging and removal required damages to be measured by the next highest use. Based on such next highest use, the award below was excessive. (Barnett-Florida)
W70-06657

WYLIE V WOOLDRIDGE (DAMAGES FOR, AND INJUNCTION TO, PREVENT EXCAVATION AND FILL).
447 SW2d 851-856 (Ark 1969).

Descriptors: *Arkansas, *Riparian rights, *Boundary disputes, *Excavation, Judicial decisions, Land use, Legal aspects, Land clearing, Land development, Land forming, Land management, Drainage, Flood control, Water conservation, Land tenure, Real property, Landfills, Bays, Inlets (Waterways), Lakes, Littoral, Channels, Backwater, Remedies, Contours.

Plaintiff's land bordered on the 400 foot contour line of a lake and was separated from defendant's land by a channel of the lake's backwater. Plaintiff contended that the defendants, in clearing their land and preparing a channel in their property, filled a portion of the lake below the 400 foot line, thereby cutting off the plaintiff's lake frontage. The court held for defendant and plaintiff appealed. The appellate court held that defendants did not cut off any of plaintiff's lake frontage. Moreover, the lower court's finding that ownership of the disputed area remained in defendants did not constitute adjudication of ownership where ownership was not in question and findings did not establish that the court intended to make a determination of ownership. (Barnett-Florida)
W70-06662

PATTON PARK V POLLAK (EASEMENT IN LAKE CREATED BY IMPOUNDMENT OF NON-NAVIGABLE STREAM).
55 NE2d 328-332 (Ind Ct App 1944).

Descriptors: *Indiana, *Lake beds, *Easements, *Impounded waters, Surface water, Beds, Ownership of beds, Judicial decisions, Legal aspects, Remedies, Lakes, Riparian rights, Streams, Dams, Water rights, Preferences (Water rights), Competing uses, Water contracts, Water law, Impoundments, Land tenure, Non-navigable waters.

The owner of lands upon which there was located a non-navigable stream granted on easement to the county for the creation, operation and maintenance of a lake. A dam was constructed which impounded the lake waters and thereby submerged lands of the owner. The county then transferred its easement to plaintiff park association, and the owner of the submerged lands then conveyed his property to the defendant. The defendant had knowledge of plaintiff's easement by record notice and personal investigation. Defendant began to use the lake waters without compensating plaintiff. Plaintiff sought to enjoin defendant from so using the waters of the lake. A judgment for defendant was reversed by the Indiana Appellate Court. The court held that the plaintiff was entitled to enjoin defendant from going upon the lake waters without paying for the privilege. The court reasoned that the easement transferred to plaintiff gave to the grantee the sole right and authority to manage and control the lake. Also, the defendant, purchaser with knowledge of property from a grantor who had previously granted an easement, took title subject to such easement. (Powell-Florida)
W70-06714

LICENSES AND PERMITS (LICENSES REQUIRED FOR HUNTING, TRAPPING AND FISHING).
Conn Gen Stat Ann secs 26-27, 26-46 (1960), as amended, (Supp 1969).

Descriptors: *Connecticut, *Permits, *Fish conservation, *Wildlife, Fishing, Commercial fishing, Sport fishing, Fish, Recreation, Legislation, Legal aspects, State governments, Regulation, Game birds, Inland waterways, Hunting, Waterfowl, Boats, Trapping, New York, Massachusetts, Rhode Island, Administration, Riparian rights.

No person over sixteen years of age shall take, hunt or trap, any animal or fish in the inland waters of this state without a license. Any domiciled landowner of this state, may hunt, trap or fish without a license on land owned or leased by him as long as he is actually domiciled there. No license is required for the oarsman or motor operator of a boat from which others are fishing. If and when the states of New York, Rhode Island and Massachusetts enact a law similar to this granting reciprocal fishing privileges, the residents of those states may fish in waters lying partly in this state and partly in the adjoining state without obtaining a non-resident fishing license. All other applicable laws of this state shall be in effect with regard to such persons. (Barnett-Florida)
W70-06716

MILLER V LUTHERAN CONFERENCE AND CAMP ASS'N (RIGHTS OF BOATING, FISHING AND BATHING IN AN ARTIFICIAL LAKE).
200 A 646-652 (Penn 1938).

Descriptors: *Pennsylvania, *Prescriptive rights, *Artificial watercourses, *Riparian rights, Easements, Judicial decisions, Legal aspects, Water rights, Artificial use, Ownership of beds, Relative rights, Riparian land, Recreation, Navigable waters, Fishing, Boating, Lakes, Boundaries (Property), Streams, Fresh water, Lake beds, Navigation, Swimming.

A corporation leased with exclusive water rights plaintiff's submerged land. The corporation then granted plaintiff the exclusive right to fish and boat in the lake. Plaintiff assigned his brother a 1/4 interest in the fishing, boating and bathing rights. Plaintiff and his brother operated boat and bath houses on the lake. The executor's of the brother's estate gave a license to defendant association for boating, fishing and bathing in the lake. Defendant owned property abutting the lake. Plaintiff sought to enjoin defendant from trespassing on the submerged land and from granting any bathing licesnes. The Pennyslvania Supreme Court affirmed the injunction decree against the defendant and held that without the common consent of plaintiff and his brother their water rights could not be commercially used, and licenses could not be issued to defendant. The court determined that plaintiff acquired the boating and fishing privileges by grant and that plaintiff and his brother acquired the bathing privilege by prescription. The court observed that in this case of a non-navigable lake, where the land under water was owned by others, no riparian rights attached to defendant's property bordering on the water. (Powell-Florida)
W70-06724

MCCLURE V COUCH (AVULSIONS AND ACCRETIONS).
188 SW2d 550-555 (Tenn 1945).

Descriptors: *Tennessee, *Avulsion, *Accretion (Legal aspects), *Boundaries (Property), Judicial decisions, Legal aspects, Bank erosion, Channels, Alluvial channels, Channel flow, Rivers, Acreage, Riparian rights, Riparian land, Land tenure, Streamflow.

A violent avulsion occurred in the river bordering the west end of the farm owned by plaintiff's father. The sudden change of the stream channel cut off a portion of the west end of the farm and created an island. The old river bed was still distinct. Plaintiff's father devised to plaintiff a portion of the farm, including two or three acres on the new island. After the avulsion, accretions totaling 27 acres were deposited against the southern border of plaintiff's island tract. Plaintiff claims the 27 acres by reason of the law controlling accretions and adverse possession. Defendant, whose land bordered the west side of the old channel of the river, claimed the accretions, also. The Supreme Court of Tennessee held that plaintiff owned the 27 acres of accretions. The court reasoned that: (1) plaintiff was the owner of the tract against which the accretions accumulated; (2) avulsion did not change the farm boundary which remained the middle of the old channel; (3) plaintiff held the major portion of the accretions by adverse possession for the requisite period; and (4) none of the accretions ever touched the property owned by the defendant. (Powell-Florida)
W70-06725

FIFE V LOCKHART (BOUNDARY DISPUTE OF LAND LOCATED AT JUNCTION OF CREEKS).
286 Ky 311, 150 SW2d 487-488 (Ky 1941).

Descriptors: *Kentucky, *Boundary disputes, *Boundaries (Property), *Alteration of flow, Bank erosion, Water law, Judicial decisions, Avulsion, Legal aspects, Streams, Streamflow, Bridges, Structures, Landfills, Junctions, Tributaries, Accretion (Legal aspects), Land tenure.

A dispute arose between plaintiff and defendant, adjoining landowners, over the ownership of a small tract of land located at the junction of two creeks. Plaintiff brought an action of ejectment against the defendant. Plaintiff contended that the building of a bridge had caused a shift in the course of one stream and thereby took land from her property and added it to defendant's property. Plaintiff contended that subsequently the bridge washed out and the creek shifted back to its original course. The appellate court held that the evidence as to any substantial shifting of the creek from its original bed was so unsatisfactory that the trial court propertly refused to submit the issue to the jury. The court also held that the plaintiff had no record title to the land and had failed to establish adverse possession. (Hubener-Florida)
W70-06726

RICHARDSON V HORN (PERMISSIVE EASEMENTS ACROSS ADJOINING LAND).
137 SW2d 394-398 (Ky 1940).

Descriptors: *Kentucky, *Easements, *Prescriptive rights, *Sewers, Adjudication procedure, Contracts, Judicial decisions, Legal aspects, Overlying proprietor, Relative rights, Water rights, Drains, Pipes, Plumbing, Drainage systems, Land tenure.
Identifiers: *Permissive use.

In 1919 a prior owner of plaintiff's land allowed the defendant to build a sewer pipe across the land; the pipe connected into a sewer on the land pursuant to a written agreement indicating that the sewer pipe would be removed if the owner of the land or any vendee thereof objected to it. In 1938, plaintiff, a distant vendee of the servient land, gave notice to defendant, owner of the dominant land, that in accordance with the agreement, the plaintiff desired the removal of the sewer pipe. The action went to

court for a declaration of the rights of the parties. The court held that in the absence of the permissive agreement, defendant would have acquired a prescriptive right to the easement over plaintiff's land. However, when the use of another's land is originally acquired by permission, the character of the use is established and it continues to be permissive until notice is brought to the owner of the land that the character of the use has been changed. Defendant's use of plaintiff's land was permissive, and plaintiff had the right to terminate such use. (Clarke-Florida)
W70-06727

HART V COPPER DIST POWER CO (SUIT FOR BREACH OF WATER-RIGHTS CONTRACT).

289 Mich 150, 286 NW 191-197 (Mich 1939).

Descriptors: *Michigan, *Water contracts, *Water rights, *Claims (Contracts), Relative rights, Land tenure, Land use, Water utilization, Legal aspects, Lakes, Water levels, Flooding, Flow, Economics, Negotiations, Contracts, Performance, Judicial decisions.

Plaintiff and defendant company entered into an agreement whereby defendant was given the option to purchase certain water rights relating to the use of water in a lake. Defendant later agreed to exercise the option, but then sought a modification in price terms before paying any money. Much correspondence between the parties ensued, at the culmination of which defendant disclaimed all obligations under the agreement and claimed that plaintiff had terminated the option. The court held that the plaintiff had not terminated the option, and that defendant had committed a breach of contract. It was found that the correspondence consisted chiefly of demands for payment by plaintiff and requests for time extensions by defendant. As plaintiff had properly tendered the deeds to the water rights, she was entitled to recover. (Caldwell-Florida)
W70-06728

BURKMAN V CITY OF NEW LISBON (PRESCRIPTIVE RIGHT TO FLOOD LAND NEAR DAM).
246 Wis 547, 19 NW2d 311-315 (Wis 1945).

Descriptors: *Wisconsin, *Dams, *Flooding, *Prescriptive rights, Dam construction, Public utilities, Mill dams, Hydraulic structures, Land tenure, Hydroelectric power, Lakes, Flow, Relative rights, Cities, Damsites, Legal aspects, Judicial decisions, Easements, Multiple-purpose reservoirs, Operation and maintenance.

Plaintiffs sought a declaration that the action of defendant city in constructing and maintaining a dam, thus flooding considerable property, was wrongful. The damsite when acquired by the city had lain unused for more than 30 years, although a mill dam had been there earlier. The city claimed that the right to flood surrounding land had been acquired by prescription by defendant's predecessors in title, and argued that no finding had been made by the trial court that this right had been abandoned. The Supreme Court of Wisconsin held that only the right to flood lands for a mill dam had been acquired by prescription, and the city had expressly given up the right to operate such dam by the terms of the deed. As the present reservoir was for a different purpose than providing a head for a mill dam, no prescriptive right for it had been acquired. Further, the period of nonuse of the damsite was held to be strong evidence of an intent to abandon any right that had originally been acquired. The city's action in building the dam and flooding the property was thus wrongful. (Caldwell-Florida)
W70-06729

6F. Nonstructural Alternatives

FLOODS IN HAMPSHIRE QUADRANGLE, NORTHEASTERN ILLINOIS,
Geological Survey, Oak Park, Ill.
Roman T. Mycyk, and Marvin D. Duerk.
Geological Survey Open-file report, June 1969. 13 p, 10 fig, 1 plate, 1 ref.

Descriptors: *Floods, *Illinois, Profiles, Maps, Data collections, Planning, Flood control, Flood plain zoning, Water management (Applied), Stage-discharge relations, Streamflow.
Identifiers: Hampshire quadrangle (Ill), Peak flow.

This report presents hydrologic data that can be used to evaluate the extent, depth, and frequency of flooding that affect the economic development of flood plains in the Hampshire quadrangle, northeastern Illinois. It will aid individuals, government agencies, and others responsible for solving the existing flood problems and for formulating effective flood-plain regulations that will minimize the creation of new flood problems. The report will also be useful for preparing building and zoning regulations, locating waste disposal facilities, developing recreational areas, and managing surface water in relation to the groundwater resources. The approximate areas inundated by floods along streams in the Hampshire quadrangle are delineated on a topographic map. The general procedure used in defining flood boundaries was to construct flood profiles from elevations of floodmarks identified in the field and from data available from other agencies. (Knapp-USGS)
W70-06351

FLOOD PLAIN INFORMATION, DEKALB COUNTY, GEORGIA.
Corps of Engineers, Savannah, Ga.
For primary bibliographic entry see Field 04A.
W70-06568

6G. Ecologic Impact of Water Development

GEOLOGIC INVESTIGATION OF THE SITE FOR AN ENVIRONMENTAL POLLUTION STUDY,
Illinois State Geological Survey, Urbana.
For primary bibliographic entry see Field 05C.
W70-06322

GEOLOGICAL INFORMATION FOR MANAGING THE ENVIRONMENT,
Illinois State Geological Survey, Urbana.
John C. Frye.
Illinois State Geological Survey Environmental Geology Note No 18, November 1967. 12 p, 1 ref.

Descriptors: *Planning, *Urbanization, *Environmental engineering, *Reviews, Engineering geology, Hydrogeology, Waste disposal, Water supply, Landfills, Water resources development, Mapping.
Identifiers: Environmental management.

The application of geologic data to solutions of problems encountered on construction projects, environmental applications, and groundwater development are reviewed. Only in the present decade has a general realization developed that--in spite of the program for the exploration of space--the physical limitations of the Earth's crust and its resources are relatively permanent as far as man's destiny is concerned. This realization, especially on the part of geologists and planners, as well as of other officials in a position to utilize the data geologists can provide, now gives promise that man will in the future be better able to cope with the environmental problems arising from the population explosion. (Knapp-USGS)
W70-06403

PULL-UP TRAP: A QUANTITATIVE DEVICE FOR SAMPLING SHALLOW-WATER ANIMALS,
Geological Survey, Miami, Fla. Water Resources Div.
For primary bibliographic entry see Field 07B.
W70-06404

URBAN ENERGY BALANCE CLIMATOLOGY,
California Univ., Los Angeles. Dept. of Geography.
For primary bibliographic entry see Field 02B.
W70-06516

THE EVERGLADES: A THREATENED ECOLOGY,
Miami Univ., Fla. Inst. of Marine Science.
C. P. Idyll.
Science Journal, Vol 5A, No 2, p 66-71, August 1969. 6 p, 5 photo, 5 ref.

Descriptors: *Wetlands, *Freshwater marshes, *Florida, *Aquatic environment, Land reclamation, Drainage, Environmental effects, Drought resistance, Habitats.
Identifiers: *Everglades.

The central part of the lower Florida peninsula is covered by an area unique in the world-the Everglades. This is an intermittent slowly flowing river 180 km long, with banks as much as 100 km apart and an average depth as little as 30 cm over great stretches. The nearly imperceptible flow (about 500 meters a day) and the immense expanse of the Everglades water are consequences of the extremely low relief of this region. Changes in the water level beginning early in this century with draining for agriculture, and continuing at an accelerated pace with recent flood control projects, are threatening to destroy the natural balance of wild life in the Everglades. Severe droughts--the most recent lasting from 1961 to 1965--have been aggravated by the flood control measures. Measures to conserve the water and thus the natural vegetation and the animals that live in it are now urgently needed. (Knapp-USGS)
W70-06539

FLOOD PLAIN INFORMATION, LITTLE TIMBER CREEK, CAMDEN COUNTY, NEW JERSEY.
Corps of Engineers, Philadelphia, Pa.
For primary bibliographic entry see Field 04A.
W70-06543

ECOLOGICAL CONSEQUENCES OF THE MANAGEMENT OF CATCHMENT AREAS AND INFLUENCE OF FORESTS ON RIVER BASINS,
For primary bibliographic entry see Field 04D.
W70-06569

07. RESOURCES DATA

7A. Network Design

NON-METROPOLITAN DENSE RAINGAGE NETWORKS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 02B.
W70-06317

EVALUATION OF THE SURFACE-WATER DATA PROGRAM IN KANSAS,
Geological Survey, Lawrence, Kans. Water Resources Div.
P. R. Jordan, and E. R. Hedman.
Kansas Water Resources Board Bulletin No 12, 1970. 49 p, 10 fig, 7 tab, 10 ref, 2 append.

Descriptors: *Data collections, *Evaluation, *Statistical methods, *Statistics, Kansas, Quality control, Sampling, Measurement, Stations, Facilities, Instrumentation, Networks, Sites.
Identifiers: Kansas surface-water data network.

Accuracy goals for surface-water gaging statistical information on Kansas are, for principal streams, accuracy equivalent to that of a 25-year record and for other streams, accuracy equivalent to that of a 10-yr record. For principal streams, the accuracy goal can be met by operation of gaging stations for 25 yr at appropriate sites. For other unregulated streams draining more than 150 square miles, the accuracy goal can be met for medium and high flows by use of the relations between streamflow characteristics and drainage basin characteristics. Low-flow characteristics can be determined by operation of low-flow partial-record stations. Operation of about 100 low-flow partial-record stations is recommended; stations can be moved to new sites after a wide range of low flows have been measured. Many complete-record stations can be discontinued unless they are needed for current-purpose data. For streams draining less than 150 sq mi, gaging should be continued for basins having a variety of physical and climatic characteristics to provide data for development of generalization methods. Continuation of a network of about 100 high-flow partial-record stations is recommended for a period of at least 5 yr. (Knapp-USGS)
W70-06330

NATIONAL REFERENCE LIST OF WATER QUALITY STATIONS - WATER YEAR 1970.
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 05A.
W70-06514

HYDROLOGICAL NETWORK DESIGN NEEDS, PROBLEMS AND APPROACHES,
J. C. Rodda, W. B. Langbein, A. G. Kovzel, D. R. Dawdy, and K. Szestay.
Summary in French, Russian, and Spanish. World Meteorological Organization Report No 12, 1969. 57 p, 14 fig, 6 tab, 119 ref.

Descriptors: *Network design, *Hydrologic data, *Data collections, Data processing, Planning, Regional analysis, Remote sensing, International Hydrological Decade, Data transmission, Instrumentation.
Identifiers: Hydrologic networks, Data requirements.

Network design enters into most aspects of hydrology; consequently, it is a topic which merits considerable attention. Lack of necessary attention results from difficulties in demonstrating the value of scientific design, problems of defining and classifying hydrological networks, and several other factors, including the absence of clear and concise objectives. Methods of design apply the concepts of regionalization, mapping and systems analysis, but the most sound design criteria are economic ones. There are no relevant economic data from networks. Some countries possess networks or plans for them which can serve as models for others. It is evident, however, that approaches to design are likely to enter a new phase of development in the near future, with the routine use of artificial satellites, automatic weather stations and computers for all aspects of data processing and analysis. This report is concerned with these and other matters pertinent to hydrological network design. It seeks to present the topic critically and cautiously as a reminder that much has still to be accomplished. (Knapp-USGS)
W70-06550

7B. Data Acquisition

APPLICATION OF RUN-LENGTHS TO HYDROLOGIC SERIES,
Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02E.
W70-06332

MACRO-TURBULENCE MEASUREMENTS IN NATURAL STREAMS,
Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics.
For primary bibliographic entry see Field 02E.
W70-06387

THE EFFECT OF AXIAL VELOCITY FLUCTUATIONS ON THE RESPONSE OF A HELICAL FLOW METER,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
For primary bibliographic entry see Field 08B.
W70-06388

TURBULENCE MEASUREMENT BY MEANS OF SMALL CURRENT METER IN FREE SURFACE FLOW,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
Yoshiaki Iwasa, and Hirotake Imamoto.
French summary included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B32, p 273-280, 1967. 8 p, 4 fig, 1 tab, 2 ref.

Descriptors: *Instrumentation, *Turbulence, *Current meters, Flow measurement, Turbulent flow, Flowmeters, Water measurement.
Identifiers: *Turbulence meters.

Equipment was designed for the measurement of temporal variation in local velocities by means of a small current meter in free surface flows. Possible use of the equipment in experimentations for turbulence measurements is discussed with observational comparisons with other methods of measurement. The mathematical analysis and observations show that the method of measurement is quite effective in obtaining the intensity of turbulence whereas it is not suitable to measure a turbulence spectrum. The effective averaging time for the intensity of turbulence is 0.1 sec and the actual total sampling time 100 sec. (Knapp-USGS)
W70-06389

EXPERIENCE WITH TURBULENCE METERS AND THEIR IMPROVEMENT,
Technische Hochschule, Munich (West Germany). Hydraulics Research Station Obernach.
Fritz Hartung, and Klausotto Csallner.
French summary included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B31, p 264-272, 1967. 9 p, 10 fig, 1 ref.

Descriptors: *Instrumentation, *Turbulence, *Current meters, Flow measurement, Turbulent flow, Flowmeters, Water measurement.
Identifiers: Turbulence meters.

Two turbulence meters can be used for qualitative and quantitative measurements within the macroturbulent area of fluids. The meters are of relatively simple design and can be produced at almost any size according to the purpose of application. They are even suitable for measurements in models. The turbulence meters operate on the basis of the induction principle. Small deflections of a metal platelet caused by transverse turbulent movements are measured by electronic equipment. (Knapp-USGS)
W70-06390

MEASUREMENT METHODS OF MACROTURBULENCE,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
Sahap Aksoy.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B30, p 256-263, 1967. 8 p, 7 fig, 1 ref.

Descriptors: *Instrumentation, *Turbulence, *Flowmeters, Vortices, Flow measurement, Turbulent flow, Calibrations, Anemometers.
Identifiers: Electrokinetic anemometers, Turbulence transducers.

An electrical-electronical system for the determination of turbulence by force transducer is described. The detecting element has a circular area of 5 mm diameter. The characteristics of the measured turbulence will be related to the size of the detecting device. Detection is based on the variation in the acting force on a deflected electrode. The principles and the description of the measuring system are given here and the application is demonstrated by an example. (Knapp-USGS)
W70-06391

POTENTIAL FLUCTUATIONS GENERATED BY TURBULENCE ON A SMALL WIRE,
Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
Gilbert Binder.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B29, p 249-255, 1967. 7 p, 6 fig, 6 ref.

Descriptors: *Instrumentation, *Flowmeters, *Turbulence, *Vortices, Flow measurement, Turbulent flow, Calibrations, Anemometers.
Identifiers: Electrokinetic anemometers, Turbulence transducers.

A new electrokinetic turbulence transducer is described and its physical mechanism is explained. Some turbulence measurements performed with this transducer are presented. Its limitations and possible applications are discussed. (Knapp-USGS)
W70-06392

AN INVESTIGATION OF WATER SURFACE TEMPERATURE BY AN AIRBORNE INFRARED RADIOMETER: LAKE HEFNER, OKLAHOMA,
Colorado State Univ., Fort Collins. Dept. of Atmospheric Science.
For primary bibliographic entry see Field 03B.
W70-06400

PULL-UP TRAP: A QUANTITATIVE DEVICE FOR SAMPLING SHALLOW-WATER ANIMALS,
Geological Survey, Miami, Fla. Water Resources Div.
A. L. Higer, and M. C. Kolipinski.
Ecology, Vol 48, No 6, p 1008-1009, Autumn 1967. 2 p, 2 fig, 1 tab, 2 ref.

Descriptors: *Trapping, *Aquatic populations, *Marshes, *Florida, Fish, Biota, Ponds, Habitats.
Identifiers: Pull-up trap, Shallow ponds, Everglades National Park.

A trap was designed for providing quantitative samples of freeswimming animals in marshes and shallow ponds. The device consists of netting tied to an aluminum frame with attachments for rapidly raising the net and entrapped organisms out of the water. Collections from a series of pull-up traps, operated monthly in Everglades National Park, provide an index of fluctuations in aquatic animal populations. (Lang-USGS)
W70-06404

FRESH WATER WHITECAPS,
Hobart and William Smith Colleges, Geneva, N.Y.
For primary bibliographic entry see Field 02L.

W70-06459

REVIEW OF NEW GEOGRAPHIC METHODS AND TECHNIQUES. QUESTIONNAIRE SURVEY. WATER RESOURCE PLANNING AND MANAGEMENT. RECENT TRENDS IN REMOTE SENSING TECHNOLOGY,
Florida Atlantic Univ., Boca Raton. Dept. of Geography.
For primary bibliographic entry see Field 06B.
W70-06466

TWO METHODS OF DESCRIBING THE 'AVERAGE' VERTICAL TEMPERATURE DISTRIBUTION OF A LAKE,
Department of Energy, Mines and Resources, Ottawa (Ontario). Marine Sciences Branch.
For primary bibliographic entry see Field 02H.
W70-06665

7C. Evaluation, Processing and Publication

USE OF DIGITAL COMPUTERS IN PROCESSING, PUBLISHING, AND ANALYZING HYDROLOGIC DATA,
Geological Survey, Washington, D.C.
W. L. Isherwood.
Nordic Hydrology, Vol 1, No 1, p 38-55, 1970. 18 p.

Descriptors: *Data processing, *Hydrologic data, *Digital computers, Data storage and retrieval, Data collections, Computer programs, Statistical methods, Documentation, Groundwater, Surface waters, Water levels, Streamflow, Sediment load, Water quality, Floods, Estuaries.
Identifiers: U.S. Geological Survey.

The use of digital computers for processing hydrological data is discussed. Digital computers have been used by the United States Geological Survey, Department of the Interior, for processing, publishing, and analyzing hydrologic data since 1956 when the first one was installed by the agency. Beginning with a few relatively simple applications to hydrology in 1956, the use of computers in this field has rapidly expanded until at present over 100 different applications are being used routinely by this agency and it is now difficult even to catalog all the various uses, particularly those in the research fields. Descriptions are given of computer processing of large masses of regularly observed basic hydrologic data from field collection, through editing and conversion to useful form, its rearrangement and summarization for periodic publication, and its entry into large computer-based storage and retrieval systems. Only a few basic ststistical analyses, these performed routinely on large blocks of data, are discussed. (Knapp-USGS)
W70-06329

CALCULATION OF SPECTRA OF TURBULENT PULSATIONS IN UNIFORM FLOWS,
For primary bibliographic entry see Field 08B.
W70-06393

SPECTRAL ANALYSIS OF DATA GENERATED BY SIMULATION EXPERIMENTS WITH ECONOMETRIC MODELS,
Duke Univ., Durham, N.C.
For primary bibliographic entry see Field 06B.
W70-06416

APPLICATION OF COMPUTER TECHNIQUES TO SEEPAGE-SALINITY SURVEYS IN KANSAS,
Geological Survey, Lawrence, Kans.
R. B. Leonard, and C. O. Morgan.
Kansas Geological Survey Special Distribution Publication 47, 1970. 44 p, 3 tab, 3 ref, 6 append.

Descriptors: *Computer programs, *Data processing, *Water quality, *Seepage, *Saline water, *Kansas, Surveys, Data collections, Hydrologic data, Groundwater movement, Return flow, Water pollution sources, Water chemistry, Digital computers.
Identifiers: Seepage-salinity surveys.

Computer programs designed to calculate and tabulate water quality data used in salinity and seepage surveys are presented. Use of the programs is illustrated by data from nine surveys made in Kansas between April 1964 and October 1968. Low streamflow was measured and samples were collected during each survey at 30 stations in the main stem and near the mouths of tributaries. Successive surveys of the reach were made to reveal progressive changes in the quantity and quality of inflow to the reach that could be attributed to irrigation return flow. The discharge measurements and results of chemical analyses comprise about 5,100 units of basic data. About 37,000 individual calculations, and tabulation of the results in a form that simplifies analysis, were made in about 3 minutes of computer time at a cost of about $50.00. Streamflow in each reach of the main stem consists principally of streamflow entering the upstream end of the reach, tributary inflow, and seepage into or out of the channel. Variations in the quantity and chemical quality of each component, or combination of components, can be evaluated. Measured or calculated output parameters are listed. (Knapp-USGS)
W70-06508

ELECTRONIC COMPUTATION OF WATER LEVELS IN RIVERS DURING HIGH DISCHARGES.
Netherlands Rijkswaterstaat, The Hague.
For primary bibliographic entry see Field 02E.
W70-06546

HYDROLOGICAL ATLAS OF CANADA.
National Research Council of Canada, Ottawa (Ontario).

Canadian National Committee for the International Hydrological Decade, Preliminary Maps, Ottawa, 1969. 6 sheets, 60 graphs, 4 maps.

Descriptors: *Water resources, *Surface waters, *Hydrologic data, *Maps, International Hydrological Decade, Hydrographs, Duration cores, Streamflow, Runoff.
Identifiers: *Canada.

Preliminary maps and graphs of the Hydrological Atlas of Canada include duration curves and maps scaled about 1 inch to 150 miles showing gaging station locations, mean streamflow, mean annual runoff, and mean distribution of runoff. Each map includes all of Canada's territory. The maps result from an initial data compilation in a program associated with the International Hydrological Decade. (Knapp-USGS)
W70-06547

AVAILABILITY OF RAINFALL-RUNOFF DATA FOR PARTLY SEWERED URBAN DRAINAGE CATCHMENTS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 02A.
W70-06573

CONVERSION OF SECTION-TOWNSHIP-RANGE TO LATITUDE-LONGITUDE-A COMPUTER TECHNIQUE,
Montana Coll. of Mineral Science and Technology, Butte.
M. K. Botz.
Available from Montana Bureau of Mines and Geology 203-B, Main Hall, Montana College of Mineral Science and Technology, Butte, Montana. Montana Bureau of Mines and Geology, Special Publication 48, December, 1969. 15 p, 3 tab, 3 fig, 4 ref, append. OWRR Project A-014-MONT (2).

Descriptors: *Computer programs, *Data processing, *Mapping, *Locating, Data storage and retrieval, Automation.

A computer technique is described that converts township, range, section, and tract locations into latitude-longitude coordinates. Using an IBM 1620 with disk storage drive, the program will calculate latitude-longitude coordinates at the rate of about 75 points per minute. The average error of the conversion is about 2.5 seconds of latitude and 2.8 seconds of longitude, and the maximum error is about 7 seconds of latitude and 8 seconds of longitude. The conversion technique is suitable for most townships in the western United States. Townships that are very irregular are not suitable for this coordinate conversion program but an extension of the logic of this program could be used to calculate coordinates in irregular townships.
W70-06702

A STUDY OF DATA PREPARATION FOR MATHEMATICAL MODELING OF AREA I OF THE HONOLULU AQUIFER,
General Electric Co., Santa Barbara, Calif. Center for Advanced Studies.
For primary bibliographic entry see Field 02F.
W70-06706

08. ENGINEERING WORKS

8A. Structures

CALIFORNIA UNDERSEA AQUEDUCT PRERECONNAISSANCE STUDY.
Bureau of Reclamation, Denver, Colo. Office of Assistant Commissioner and Chief Engineer.

Bureau of Reclamation Reconnaissance Study Report, December 1969. 101 p, 3 fig, 510 ref.

Descriptors: *Aqueducts, *Underwater, *California, Water conveyance, Geology, Hydraulics, Ecology, Oceanography, Hydrodynamics, Costs, Water law, Legal aspects, Water demand, Cost-benefit analysis, Systems analysis.
Identifiers: California underwater aqueduct.

A preliminary study of the feasibility of an underwater aqueduct to supply water to coastal areas of California includes investigations of present water import, alternate sources of water to those now used, demand, supply in northern California, ecology, bathymetry, geology, soils engineering, ocean hydrodynamics, costs, legal aspects, and a systems analysis study of the plan. The prereconnaissance study indicates that a total fund requirement of $2,188,000 and a period of 5-1/2 years will be needed to complete the reconnaissance investigation. Based on rough cost estimates prepared by National Science Engineering Company, and modified by the Bureau, it is concluded that as nearly as can now be determined, it is possible that the cost of water delivered through the aqueduct could be competitive with the cost of water delivered from other potential sources. However, many complex engineering and other technical problems associated with the potential aqueduct are not well understood. (Knapp-USGS)
W70-06366

SAFETY INSPECTION OF HYDRO PROJECTS--FPC ORDER 315,
Federal Power Commission, Fort Worth, Tex.
Arthur Martin, Jr.
Pap, Amer Soc Civ Eng, Nat Water Resour Conf, Memphis, Tenn, Jan 1970. 8 p.

Descriptors: *Safety, *Inspection, *Dams, Hydroelectric project licensing, Consulting engineers, Earth dams, Concrete dams, Operation and maintenance, Requirements, Dam failure.
Identifiers: *Regulations, Federal Power Commission, Engineering evaluation.

Dams are being constructed at sites and of heights considered unthinkable a number of years ago. Increasing numbers of dams, increasing population, and past failures and near failures of dams have caused increasing emphasis and concern about the safety of dams. Consequently, the Federal Power Commission, which is responsible for the safety of over 600 dams, issued Order 315 (now Part 12 of the FPC regulations) providing for periodic inspection of dams by independent consultants. The regulations require inspection at 5-yr intervals of dams exceeding 35 ft in height and dams that form reservoirs having a gross storage capacity of more than 2000 acre-ft. Inspection of new projects is required within 5 yr after construction. The regulations provide for the use of special equipment, instrumentation, procedures, and inspection staff, and specify other requirements to be covered by the inspection. Some results of inspections and the approaches used by the consultants are described. (USBR)
W70-06372

DEPOSITION AND SCOUR DOWNSTREAM FROM SEMIPERMEABLE STRUCTURES,
Technical Univ. of Istanbul (Turkey). Dept. of Hydraulic and Water Power.
Kazim Cecen, and Mehmetcik Bayazet.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B22, p 186-193, 1967. 8 p, 6 fig, 2 ref.

Descriptors: *Dams, *Dam construction, *Sedimentation, *Dam design, *Deposition (Sediments), Scour, Sediment transport, Sediment load, Model studies, Bed load, Hydraulic models, Turbulence, Earth dams, Hydraulic-fill dams.
Identifiers: Semipermeable dams.

Means of constructing small dams on rivers at a low cost by depositing the sediment load of the stream using semipermeable structures were investigated. Previous studies showed that some types of screens could be used for this purpose. Experiments were made with various types of structures, different properties of flow and sediment, to determine the best type to use in natural streams. Owing to the abundance of parameters, a series of initial runs were made to determine the proper types of structures. It was found that a structure consisting of parallel fine screens gave good results. Such a structure that causes a sill to be built downstream as a result of reduction of macroturbulence was tried with various flow conditions and sediments. The influences of slope of screens, distance between them and their height were determined. Two types of sediment were used in these experiments: uniform sand, and tuff that has a graded size distribution. This made it possible to compare the effects of size distribution. Evolved type of structure can be built on natural streams using fence wire, etc. The sill to be deposited below such a strucutre can be stabilized and used as a small dam. Scour that would occur downstream can also be prevented at a low cost by using parallel screens. (Knapp-USGS)
W70-06385

A DAM ACROSS THE AMAZON,
Hudson Inst., Inc., Croton-on-Hudson, N.Y.
For primary bibliographic entry see Field 04A.
W70-06538

8B. Hydraulics

SIMILARITY IN UNLINED IRRIGATION CANAL SYSTEMS,
Southampton Univ. (England). DEPT. OF Civil Engineering.
Kenneth V. H. Smith.
ASCE Proceedings, Journal of the Hydraulics Division, Vol 96, No HY 1, Paper 6993, p 13-28, January 1970. 16 p, 11 fig, 3 tab, 14 ref, append.

Descriptors: *Open channel flow, *Canals, *Alluvial channels, *Channel morphology, *Hydraulic similitude, Hydraulics, Irrigation canals, Regime, Dunes, Ripple marks, Roughness (Hydraulic), Sediment transport, Particle size.
Identifiers: Unlined canals.

Data from three irrigation canal systems are examined, and the observed variations in some relevant flow parameters are considered in relation to the conditions which apply in the case of completely similar movable bed channel flows. It can be seen that the canals flow with ripple, dune, or transitional bed regimes, and that the bed material size decreases in a downstream direction in such a way that the ratio of the mean velocity of flow to the fall velocity of the bed material tends to remain constant. It is shown that it is impossible for complete similarity to exist between the flows in real alluvial channels, and accordingly an attempt is made to define conditions of quasi-similarity based on the stage of development of the bed formation. (Knapp-USGS)
W70-06333

TURBULENCE IN THE MISSISSIPPI RIVER,
Army Engineer Waterways Experiment Station, Vicksburg, Miss.
Joseph B. Tiffany.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ. Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B41, p 349-355, 1967. 7 p, 4 fig.

Descriptors: *Turbulence, *Mississippi River, *Scour, Hydraulics, Vortices, Eddies, Instrumentation, Flow measurement, Flowmeters, Current meters, Water measurement, Turbulent flow, Floods, Streamflow.
Identifiers: Macroturbulence, Turbulence meters.

Turbulence in the Mississippi River is of particular interest because of its effects on revetment used to stabilize the erodible banks of the river. Velocity fluctuation measurements indicated an approximate 20-minute cycle with a superimposed cycle averaging about 3 minutes. Since most standard discharge measurements include a 5-minute observation at a given point in a vertical, considerable deviation from the long-time true average velocity could result. The turbulence patterns had spatial dimensions at least of the order of the depth of the river at the point of observation. A hydrodynamic pulsimeter consisting of a cast-iron disk with a pressure cell set in its surface and a current meter suspended above the surface was developed. During the 1950 flood, velocity measurements at 42 points in depths to 100 feet ranged from 2 to 15 feet per second. Differences in pressure of as much as 0.5 pounds per square inch occurred in about 15 to 30 seconds, and deviations from the average velocity of as much as 4 to 6 feet per second occurred in very short time intervals. Uplift pressures in the Mississippi River are capable of lifting concrete slabs as thick as 6 inches from the river bottom. (Knapp-USGS)
W70-06382

SOME CHARACTERISTICS OF MACRO-TURBULENCE IN FLOW PAST A NORMAL WALL,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Frederick A. Locher, and Eduard Naudascher.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2, (Macroturbulence and stochastic processes in hydraulics), Paper B35, p 298-307, 1967. 10 p, 7 fig, 9 ref.

Descriptors: *Turbulent flow, *Open channel flow, *Vortices, *Turbulence, Cavitation, Aeration, Flow separation Hydraulic structures, Pressure, Scour, Hydraulics, Open channels.
Identifiers: Macroturbulence, Secondary currents.

Abrupt changes in boundary form are the rule rather than the exception in much of Civil Engineering design. The normal wall of finite thickness placed on a boundary is among the geometric configurations often encountered in hydraulic structures, as in gated outlet works. An extensive investigation of the pressure fluctuations in the vicinity of such a wall has been undertaken to obtain a better understanding of the mechanism by which structural vibrations are induced. The results presented herein include the spectral distribution and RMS values of the pressure fluctuations near a stationary wall as affected by the relative wall thickness and cavitation. A dominant frequency is shown to be associated with an unstable flow reattachment near the downstream edge of the wall and with the unsteadiness of the overall extent of the separation zone. Cavitation is found to increase both the periodicity and the amplitude of the pressure fluctuations. (Knapp-USGS)
W70-06383

THE TURBULENT STRUCTURE OF OPEN RESTRICTED DEPTH FLOW WITH INTERFACE,
Akademiya Nauk URSR, Kiev.
N. G. Pozniaja.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B36, p 308-314, 1967. 7 p, 2 fig, 3 ref.

Descriptors: *Turbulent flow, *Stratified flow, *Vortices, *Open channel flow, *Stratification, Interfaces, Boundary processes, Jets, Model studies, Hydraulic structures, Pressure, Hydraulics, Open channels.
Identifiers: Macroturbulence.

The macroturbulence caused by the interface between the transit flow and lateral roller in abrupt two-dimensional flow expansion is studied experimentally for determination of vortex zone resistance to transit jet motion. It has been established that the sign change of correlation moment between longitudinal and vertical fluctuations for the depth is the characteristic feature of the turbulent structure on the interface. The analysis of mean motion energy balance equation proves that the change of signs is caused by hightened resistance induced by vortexes with a vertical core in the boundary zone near the flow surface. This resistance is very important in calculation of two-dimensional flow expansion behind the hydraulic structures. (Knapp-USGS)
W70-06384

A COMPUTATIONAL INVESTIGATION OF IMPULSIVELY-GENERATED EDDIES,
Iowa Univ., Iowa City. Inst. of Hydraulic Research.
Tin-Kan Hung.
French summary included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B37, p 315-322, 1967. 8 p, 2 fig, 6 ref.

Descriptors: *Turbulent flow, *Eddies, *Vortices, *Flow separation, *Unsteady flow, Energy dissipation, Mathematical studies, Cavitation, Hydraulics, Open channels, Open channel flow.
Identifiers: Macroturbulence.

The eddy formation accompanying an impulsive acceleration of an incompressible fluid through a two-dimensional symmetric conduit expansion is computed from the basic equations of motion by using a finite-difference scheme. The primary transient characteristics of such an impulsively-generated eddy are its large vorticity and high rate of energy dissipation. The calculated results are presented as contours of constant values of the stream function, vorticity, viscous stresses, and Bernoulli-sum. The distribution of each of the sig-

nificant physical quantities in the work-energy equation in the zone of separation is shown in the vicinity of the expansion. (Knapp-USGS)
W70-06386

MACRO-TURBULENCE MEASUREMENTS IN NATURAL STREAMS,
Ceskoslovenska Akademie Ved, Prague. Inst. of Hydrodynamics.
For primary bibliographic entry see Field 02E.
W70-06387

THE EFFECT OF AXIAL VELOCITY FLUCTUATIONS ON THE RESPONSE OF A HELICAL FLOW METER,
Geological Survey, Fort Collins, Colo.; Colorado State Univ., Fort Collins. Dept. of Civil Engineering.
Erich J. Plate.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ. Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B33, p 281-289, 1967. 9 p, 3 fig, 1 tab, 7 ref.

Descriptors: *Flowmeters, *Turbulent flow, *Calibrations, Laboratory tests, Current meters, Flow measurement, Turbulence, Instrumentation, Water measurement.
Identifiers: *Turbulence effects (Flowmeters), Helical flowmeters.

The work of Grey and Jepson on the response of a helical flowmeter to a step velocity input is extended to the case of a sinusoidally varying axial velocity fluctuation superimposed on a mean velocity. The dynamic equation is derived and solved for small amplitude fluctuations. The meter should over-register if axial turbulence is present by an amount which, to a first approximation, is proportional to the square of the ratio of the amplitude of the sinusoidal velocity to the mean velocity. The result is compared with data of Fischer. Qualitative agreement is found, but the experimental data do not contain enough information for evaluating all the parameters which appear in the solution. (Knapp-USGS)
W70-06388

TURBULENCE MEASUREMENT BY MEANS OF SMALL CURRENT METER IN FREE SURFACE FLOW,
Kyoto Univ. (Japan). Dept. of Civil Engineering.
For primary bibliographic entry see Field 07B.
W70-06389

EXPERIENCE WITH TURBULENCE METERS AND THEIR IMPROVEMENT,
Technische Hochschule, Munich (West Germany). Hydraulics Research Station Obernach.
For primary bibliographic entry see Field 07B.
W70-06390

MEASUREMENT METHODS OF MACROTURBULENCE,
State Hydraulic Works, Ankara (Turkey). Dept. of Research.
For primary bibliographic entry see Field 07B.
W70-06391

POTENTIAL FLUCTUATIONS GENERATED BY TURBULENCE ON A SMALL WIRE,
Colorado State Univ., Fort Collins. Fluid Dynamics and Diffusion Lab.
For primary bibliographic entry see Field 07B.
W70-06392

CALCULATION OF SPECTRA OF TURBULENT PULSATIONS IN UNIFORM FLOWS,
V. M. Ljatkher.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B3, p 17-35, 1967. 19 p, 4 fig, 11 ref.

Descriptors: *Turbulent flow, *Mathematical studies, Vortices, Open channel flow, Closed conduit flow, Boundary processes, Viscosity, Shear drag.
Identifiers: Spectral analysis.

The turbulent spectra of velocity and pressure pulsations in uniform flows (inside the flow core and in viscous sublimation on the flow boundary) are calculated on the base of viscous fluid motion equations given in the Helmholtz form and linearized against velocity pulsation components. The qualitative difference of pulsation spectra in free surface flow and flow under pressure is discussed. Calculation and experimental results are compared. They confirm the need for further development of the proposed method. (Knapp-USGS)
W70-06393

LARGE EDDIES IN STRATIFIED FLOW,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
Mikio Hino, Hiroshi Shikata, and Mayuki Nakai.
French resume included. Proceedings 12th Congress of International Association for Hydraulic Research, Sept 11-14, 1967, Colorado State Univ, Fort Collins, Vol 2 (Macroturbulence and stochastic processes in hydraulics), Paper B8, p 61-73, 1967. 13 p, 10 fig, 27 ref.

Descriptors: *Turbulence, *Vortices, *Stratified flow, *Open channel flow, Model studies, Hydraulic models, Mixing, Interfaces, Stratification.
Identifiers: *Macroturbulence, Longitudinal vortices.

By the application of 'hydrogen bubble' technique of flow visualization the stability and formation of large eddies and turbulence are measured in both homogeneous and stratified flows. There has been observed a marked difference between the two flows, particularly the suppression of transition from laminar to turbulence, the reduced intensity of longitudinal vortices, and the decrease in the Karman constant for stratified flow. Additional experiments on the generation of the Karman vortex in both flows are discussed. The same technique is also applied to study the interfacial structure of two-layered flows. (Knapp-USGS)
W70-06394

DYANMIC HYDROLOGY,
Massachusetts Inst. of Tech., Cambridge. Dept. of Civil Engineering.
For primary bibliographic entry see Field 02A.
W70-06522

EFFECT OF A STABILIZING GRADIENT OF SOLUTE ON THERMAL CONVECTION,
Yale Univ., New Haven, Conn. Dept. of Geology and Geophysics.
For primary bibliographic entry see Field 05B.
W70-06641

THE UNSTABLE THERMAL INTERFACE,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
J. W. Elder.
Journal of Fluid Mechanics, Vol 32, Part 1, 1968, p 69-96. 21 fig, 23 ref.

Descriptors: *Thermal stratification, *Turbulence, Porous media, Viscous flow.
Identifiers: *Thermal turbulence.

This study investigates the motion which develops in a deep layer of a viscous, thermally conducting fluid initially hot below and cold above some horizontal plane, so that the system is gravitationally unstable, by laboratory and numerical experiments. Three cases are considered: (1) the flow which occurs in a porous medium when the interface is the lower boundary of the system; (2) a similar study in a viscous fluid; (3) an interface distant from the confining horizontal boundaries, in a viscous fluid. In all cases the initial development of the flow occurs within the thermal interface between the hot and cold fluid. The development of the disturbances in the interface involves: a period in which the diffusion of heat and vorticity dominate; a period involving rapid amplification with diminishing importance of the role of diffusion of heat; a period of emergence of the disturbances from the interface, during which the accelerations are sufficiently rapid for molecular processes to be unimportant, entrainment being the dominant process; and finally a period of adjustment of the large eddies. The amplification process is adequately described by the linearized equations of motion. (Guerrero-Vanderbilt)
W70-06643

THE THERMOHALINE RAYLEIGH-JEFFREYS PROBLEM,
Auckland Univ. (New Zealand). Dept. of Mathematics.
For primary bibliographic entry see Field 05B.
W70-06644

THE INFLUENCE OF MOLECULAR DIFFUSIVITY ON TURBULENT ENTRAINMENT ACROSS A DENSITY INTERFACE,
Cambridge Univ. (England). Dept. of Applied Mathematics and Theoretical Physics.
J. S. Turner.
Journal of Fluid Mechanics, Vol 33, Part 4, 1968, p 639-656. 6 fig, 12 ref.

Descriptors: *Density stratification, *Thermal stratification, *Interface, *Mixing.
Identifiers: *Richardson number, *Entrainment.

The rate of mixing across a density interface between two layers of liquid has been measured in a laboratory experiment which allows a direct comparison between heat and salinity transports over the same range of density differences. Low Reynolds number turbulence was produced by stirring mechanically at a fixed distance from the interface. For density differences produced by heat alone, the functional dependence is close to Ri-1 except at small values of Ri where it approaches a finite limit. For experiments with a salinity difference across the interface, the mixing rate is the same as in the heat experiments at low values of Ri, but falls progressively below this as Ri is increased, with the approximate form Ri-3/2. An interpretation of these results has been attempted, using a dimensional analysis and qualitative mechanistic arguments about the nature of the motion. The decreased mixing rates for salt have been attributed to a slower rate of incorporation of an entrained element into its surroundings by diffusion, which increases the tendency for it to return to the interface and dissipate energy in wave-like motions. (Guerrero-Vanderbilt)
W70-06646

A NOTE ON THE STEADY TWO-DIMENSIONAL FLOW OF A STRATIFIED FLUID OVER AN OBSTACLE,
Melbourne Univ., Parkeville (Australia). Dept. of Mathematics.
R. Grimshaw.
Journal of Fluid Mechanics, Vol 33, Part 2, 1968, p 293-301. 15 ref.

Descriptors: *Stratified flow, *Froude number, Open channel flow, Fluid mechanics.
Identifiers: *Wave equation.

A study was conducted of the steady two-dimensional flow of an inviscid incompressible fluid of variable density in a long channel, bounded above by a rigid horizontal plane and below by an obsta-

cle. For certain variations with height of the speed and density in the incident stream, the governing equation is the reduced wave equation. Drazin and Moore (1967) have used this fact to develop a wave-guide analogy. The wave-guide analogy is further developed and several uniqueness theorems obtained. When the obstacle satisfies a certain convexity condition it was shown that the upstream conditions and the obstacle uniquely determine the flow; that is, there is no critical internal Froude number or obstacle height for which the problem fails to be well posed. (Guerrero-Vanderbilt)
W70-06647

THE STABILITY OF A STRATIFIED FLUID,
Monash Univ., Clayton (Australia). Dept. of Mechanical Engineering.
J. B. Hinwood.
Journal of Fluid Mechanics, Vol 29, Part 2, 1967, p 233-240. 8 fig, 3 ref.

Descriptors: *Stratified flow, *Interface, *Model studies, *Stability, Fluid mechanics.

This study investigated the stability of the interface between two liquid strata of equal depth and discharge for the case of no relative motion between the strata. Hence the presence of viscous shear at the interface is no longer the primary cause of instability. This study was concerned with two miscible strata with a very small difference in density. The experiments were performed in a rectangular conduit of black lucite, 6 in. wide, 2 in. deep and 130 in. long, connected to a large stationary head tank at the upstream end, and a flow meter and a small moveable overflow tank at the downstream end. It was maintained at constant discharge through the unit. Some conclusions were: (a) A stably stratified flow with no interfacial shear is sometimes less stable than an unstratified flow, despite the stabilizing influence of gravitational forces. (b) The upper and lower critical Reynolds numbers are functions of the interfacial Froude number F, and that if F is large they are lower than for a homogeneous flow. (c) In stratified flows the disturbances leading to turbulent flow sometimes arise at the interface and lead to interfacial waves, whose wavelength at breaking is equal to the conduit depth. (Guerrero-Vanderbilt)
W70-06648

THE STABILITY OF THERMALLY STRATIFIED PLANE POISEUILLE FLOW,
Chicago Univ., Ill.
K. S. Gage, and W. H. Reid.
Journal of Fluid Mechanics, Vol 33, Part 1, 1968, p 21-32. 4 fig, 13 ref, 2 tab.

Descriptors: *Stratified flow, *Stratification, *Stability, Flow, Thermal stratification.
Identifiers: *Richardson number, *Prandtl number.

This study investigates the stability of a thermally stratified fluid in the presence of a viscous shear flow, in the situation in which there is an important interaction between the mechanism of instability due to the stratification and the Tollmien-Schlichting mechanism due to the shear. A complete analysis had been carried out for the Benard problem in the presence of a plane Poiseuille flow and it is shown that, although Squire's transformation can be used to reduce the three-dimensional problem to an equivalent two-dimensional one, a theorem of Squire's type does not follow unless the Richardson number exceeds a certain small negative value. This conclusion follows from the fact that, when the stratification is unstable and the Prandtl number is unity, the equivalent two-dimensional problem becomes identical mathematically to the stability problem for spiral flow between rotating cylinders. To obtain a quantitative comparison between theoretical and observed results, it will be clearly necessary to consider the stability of stratified shear flows for more general classes of temperature and velocity profiles. (Guerrero-Vanderbilt)
W70-06651

REDUCTION OF RIVER HEAT POLLUTION BY TURBULENCE STIMULATION,
Connecticut Univ., Storrs. Inst. of Water Resources.
For primary bibliographic entry see Field 05D.
W70-06704

8C. Hydraulic Machinery

REDUCTION OF NOISE AND VIBRATIONS IN A HYDRAULIC TURBINE,
Central Research Inst. of Electric Power Industry, Tokyo (Japan).
T. Sagawa.
Trans Amer Soc Mech Eng, Vol 91, Ser D, No 4, p 722-727, Dec 1969.

Descriptors: *Hydraulic turbines, *Noise, *Vibrations, Pressure, Flow, Turbine blades, Turbine runners, Francis turbines, Hydraulic machinery, Investigations, Guide vanes, Field tests, Velocity, Vortices.
Identifiers: *Foreign testing, Japan, Test results, Pressure waves.

Test procedures used to isolate and reduce abnormal noise and vibration in hydraulic turbines are described. During a period of 1-1/2 yr, the noise level, vibrations, and pressures were measured in various operating conditions of 2 turbines in a Japanese powerplant, and various corrective methods were investigated. Separated flows entering a turbine have a small random pressure fluctuation producing a singular frequency, which, if near the natural frequency of the runner blades, can cause severe vibrations in the runner. Modifying the runner blading eliminated the noise and vibrations. (USBR)
W70-06367

ADDITIONS TO CHIEF JOSEPH DAM POWER PROJECT,
Corps of Engineers, Seattle, Wash.
A. Lee Warbington.
Pap, Amer Soc Civ Eng, Nat Water Resources Eng Meet, Memphis, Tenn, Jan 1970. 38 p, 8 fig, 16 tab.

Descriptors: *Hydroelectric plants, Hydroelectric power, Enlargements (Structures), Project benefits, Project feasibility, Project planning, Comparative benefits, Generators, *Power head, Powerhouses, Cost-benefit analysis, Future planning (Projected), Peaking capacities, Peak power, *Design criteria, Concrete dams, Cost comparisons.
Identifiers: *Chief Joseph Dam Proj (Wash), Comparative studies, Design assumptions, Changed conditions, Grand Coulee Powerplant (Wash).

Studies to determine the rated head for 11 additional generating units scheduled for installation at Chief Joseph Dam Project on the Columbia River in Washington are presented. Planning and design studies for the present facility and changed conditions since the initial construction are discussed. Several possible schemes for future expansion beyond the 11 scheduled units were considered because of their effect on the rated head for the scheduled units. Large potential net power benefits could be gained by raising the pool elevation and adding additional units at a later date. Powerhouse extension is physically and economically feasible, and the pool elevation can be raised by modifying the dam, spillway, and powerhouse. If additional units are added, the optimum pool elevation would be 24 ft above the present pool elevation. To allow for full utilization of additional head prompted by future additional units, design head for the scheduled 11 units should be based on a 24-ft rise in pool elevation. Benefit-cost data are presented. Effects of an increased pool elevation at Chief Joseph Dam on power production at Grand Coulee Dam, located 51 mi upstream, are discussed. (USBR)
W70-06373

ESTIMATING THE SWITCHING SURGE PERFORMANCE OF TRANSMISSION LINES,
Westinghouse Electric Corp., East Pittsburgh, Pa.
A. R. Hileman, P. R. Leblance, and G. W. Brown.
Trans Pap 70 TP 38-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1970. 15 p, 26 fig, 2 tab, 9 ref, 2 append.

Descriptors: *Transmission lines, *Extra high voltage, Estimating, *Probability, Circuit breakers, Resistors, Investigations, Histograms, Polarity, Electric insulation, Electric currents, Test facilities, Theory, Calculations, Faults (Electrical), Electrical design.
Identifiers: *Switching surges, *Flashover, Overvoltage Test results, Electric discharges, *Ultra high voltage.

A simplified method of estimating the switching surge flashover probability of a transmission line is developed and presented in a series of curves. Any simplified method requires making 2 obvious assumptions: (1) the frequency of occurrence of switching surge voltages, and (2) the probability of flashover of tower insulation as a function of voltage. A miniature system study on a 125-mi, 1100-kv transmission line was performed to investigate the probability distribution and the validity of the 2 assumptions. Results were used to produce sets of curves from which estimates of the switching surge flashover probability can be determined. The miniature system study is discussed, and a schematic of the 1100-kv study circuit is shown. Histograms of absolute peak voltages and switching surge flashover probability curves are included. (USBR)
W70-06375

A TRANSFORMER CORONA TEST ON SWITCHING OVERVOLTAGES,
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
L. C. Aicher.
Conf Pap 70 CP 121 - PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1970. 5 p, 1 fig, 7 ref.

Descriptors: *Power transformers, Dielectrics, *Electrical coronas, Radio interference, *Test procedures, *Electric insulation, Lightning arresters, Performance tests, Instrumentation, Deterioration.
Identifiers: *Electric discharges, *Switching surges, *Overvoltage, Dielectric breakdown, Insulating oil, Flashover, Test results.

Power transformer dielectric requirements have been modified to meet operating conditions more adequately or economically. New dielectric tests have been developed to demonstrate that the qualities necessary to fulfill requirements have been provided. Among the tests applied to a growing number of high-voltage power transformers is one referred to as radio noise, radio influence voltage, corona, or partial discharge. A test method is presented that will alleviate growing concern of the integrity of reduced BIL transformers, with respect to corona. The transformer would be subject to a partial discharge test at a voltage level related to the maximum voltages that will be experienced in service. The proposed test voltage is related to the low frequency equivalent of the maximum switching surge voltage that the protective lightning arrester will permit on the transformer. Being essentially free of partial discharges, as determined with appropriately sensitive instrumentation, ensures that the transformer has the corona characteristic conducive to long life. (USBR)
W70-06376

CONTROLLING SWITCHING SURGES ON 1100-KV TRANSMISSION SYSTEMS,
Westinghouse Electric Corp., East Pittsburgh, Pa.
J. K. Dillard, J. M. Clayton, and L. A. Kilar.
Trans Pap 70 TP 76-PWR, Inst Elec Electron Eng Winter Power Meet, New York, N Y, Jan 1970. 11 p, 8 fig, 6 tab, 9 ref.

Descriptors: *Transmission lines, *Electric insulation, Extra high voltage, Circuit breakers, Resistors, Investigations, Analog computers, Theory, Faults (Electrical), Calculations, *Electrical design, Lightning arresters, Dielectrics, Feasibility, Economics.
Identifiers: *Ultra high voltage, *Switching surges, *Overvoltage, Flashover, Test results, Electric discharges, Shunt resistors.

One great technical challenge facing ultra high voltage transmission is effectively contolling transient overvoltages caused by switching transmission lines. At high operating voltages, uncontrolled switching surges pose the greatest stress on system insulation and consequently dictate insulation levels throughout the system. A study was made using an analog computer to evaluate the technical feasibility of various alternatives for limiting switching surges on future 1100-kv transmission systems. Various alternatives for limiting switching surges, including controlled and uncontrolled, multistep resistor breakers, were investigated under different system conditions. Several alternatives were capable of limiting surge magnitudes to acceptable values. A description of the system used, the effects of system parameters, and results of the study are given. (USBR)
W70-06378

FULLY WATER-COOLED 190 MVA GENERATORS IN THE TONSTAD HYDROELECTRIC POWER STATION,
Bown, Boveri and Co. Ltd., Baden (Switzerland).
E. Ostby, and K. Gamlesaeter.
Brown Boveri Rev, Vol 56, No 8, p 380-385, Aug 1969. 6 p, 8 fig, 1 tab, 1 ref.

Descriptors: Hydroelectric power, *Electric generators, Losses, *Water cooling, *Stators, *Rotors, Electrical design, Deaeration, Stress, Fresh water, Thermal stress, Foreign design practices.
Identifiers: Norway, Deionization, *Machine design, Service life.

Design features of 2 fully water-cooled 190 mva hydroelectric generators in service for about one year at the Tonstad plant in Norway are described. The stator and rotor windings are cooled by a closed-circuit system containing deionized and deaerated water. Stator laminations and pressure plates are cooled by ordinary fresh water. Advantages of direct water-cooling are enumerated. Operation of these machines has been satisfactory, and experience gained forms an important base for further development of fully water-cooled generators. (USBR)
W70-06379

HYDRAULICS OF A PRESSURIZED SEWERAGE SYSTEM AND USE OF CENTRIFUGAL PUMPS,
American Society of Civil Engineers, New York.
For primary bibliographic entry see Field 05G.
W70-06406

ECONOMIC ASPECTS OF HYDRO POWER,
Water Power Inc., London (England).
For primary bibliographic entry see Field 06C.
W70-06407

SEWAGE PLANT DESIGNED FOR FLUCTUATING POPULATION,
Nebolsine, Toth and McKee, Fort Lee, N.J.
For primary bibliographic entry see Field 05D.
W70-06587

8D. Soil Mechanics

STATE-OF-THE-ART SURVEY SOIL STABILIZATION, VOLUME I,
Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.
Hans F. Winterborn.
Available from the Clearinghouse as AD-846 786, $3.00 in paper copy, $0.65 in microfiche. Distribution limitation now removed. Engineering Dept. Report No. NAEC-ENG-7469, Vol I. Phila., Penn. Dec. 13, 1968, 107 p.

Descriptors: *Soil stabilization, Soil properties, Soil types, Clays, Sands, *Soil sealants, Electro-osmosis.
Identifiers: *Stabilized soil systems.

An extensive state-of-the-art survey on methods of soil stabilization has been conducted, with the aim of compiling an authoritative and convenient source of reference. In volume I of this report, the nature of soil stabilization as a progressing science is discussed, and eight methods are presented in detail. Volume II will provide a reliable guide as to which of the abundant methods should be used for a given task under specific conditions.
W70-06463

8E. Rock Mechanics and Geology

ROCK MOVEMENT AND SUBSEQUENT STABILIZATION - MORROW POINT UNDERGROUND POWERPLANT,
Bureau of Reclamation, Denver, Colo.
Gilbert L. Brown, Ernest D. Morgan, and Jerry S. Dodd.
Pap Amer Soc Civ Eng Nat Meet Water Resour, Memphis, Tenn, Jan 1970. 66 p, 28 fig, 1 tab, 6 ref, append.

Descriptors: Hydroelectric power, *Electric generators, Losses, *Water cooling, *Rotors, Electrical design, Deaeration, Stress, Fresh water, Thermal stress, Foreign design practices.
Identifiers: Norway, Deionization, *Machine design, Service life.

During excavation of the underground Morrow Point Powerplant in Colorado, an extensive rock monitoring system detected inward movement along a longitudinal rock face of the powerplant chamber. The movement was associated with a large rock polyhedron formed in part by 2 intersecting faults and the powerplant rock wall. Investigations indicated that further movement was possible, necessitating installation of a permanent restraint system. Geology of the damsite and powerplant area, preconstruction rock stability analysis, instrumentation, rock movement, analysis to evaluate rock movement, and measures to stop the movement are described. Anchor bars, long rock bolts, poststressed tendons, and flat jacks were selected to provide the required support. The restraint system, designed out of necessity by intuitive engineering judgement, proved to be properly designed on the basis of an improved method of rock mechanics analysis. (USBR)
W70-06381

THE BIRTH AND DEVELOPMENT OF THE CONCEPT OF DIAGENESIS,
Strasbourg Univ. (France). Inst. of Geology.
For primary bibliographic entry see Field 10.
W70-06398

8G. Materials

HVDC EFFECTS ON PIPE LINES,
Cornell, Howland, Hayes and Merryfield, Corvallis, Oreg.
Thomas B. Hayes, George H. Silkworth, and Robert D. Schilling.
Pipe Line Ind, Vol 32, No 2, p 27-30, 54, Feb 1970. 5 p, 8 fig.

Descriptors: *Pipelines, *Corrosion, *Extra high voltage, Transmission (Electrical), Coatings, *Direct current, Electric fields, Electrical properties, Electrical potential, Electrodes, Corrosion control, Cathodic protection, Electrical grounding, Polarity, *Electric currents.
Identifiers: *Ground currents, *Stray current corrosion, Buried pipes, Corrosion currents, Ground return, Earth resistivity (Elect).

A pipeline collects, conducts, and discharges electric current of high-voltage, direct-current (hvdc) origin as a result of the electric field established by the d-c current transmitted through the earth, and by the electrical properties of the pipeline. Methods used to calculate quantitative characteristics of the earth's gradient and hvdc effects on pipelines are given. Requirements for protection along the pipeline from corrosion or disbonding are developed and results are given. The upper limit of protection is the maximum amount of current that can be collected by the pipeline without exceeding the disbonding limit. The lower limit of protection is the minimum amount of current that can be collected by the pipeline to keep it above the corrosion limit. (USBR)
W70-06377

MATERIALS OF CONSTRUCTION FOR TRADE WASTE TREATMENT PLANTS,
Prodorite Ltd., Birmingham (England).
D. V. Paradington.
Water Pollution Control, London, Vol 67, No 3, 1968. p 269-275, 2 fig, 2 ref.

Descriptors: *Construction materials, *Corrosion, *Costs, Reliability, Pumps, *Waste treatment, Waste water treatment.
Identifiers: *Trade waste, *Treatment plant, *Corrosive liquors, *Chemical resistance, Plant design, Contaminants, Pipe work.

A general background is presented relating to the difficulties confronting the plant designer when selecting the materials of construction for a trade waste treatment plant. Particular emphasis is given to the construction of tanks. Construction materials should have chemical-resisting capacity. Attention should be paid to such factors as the risk of mechanical damage and thermal conditions. Selection of materials for pumps should be consulted with pump manufacturers. The need is emphasized for plastic pipes. The chemical resistance of any construction material depends upon the individual contaminants present, and therefore it can be dangerous to generalize any point. For this reason final selection of material should be left to the specialist engineer. While great reliance is placed on conventional techniques, the use of synthetic material is assuming an ever increasing importance. (Shankar-Texas)
W70-06586

8H. Rapid Excavation

GEOHYDROLOGY - PROJECT RULISON, GARFIELD COUNTY, COLORADO,
Geological Survey, Denver, Colo.
P. T. Voegeli, Sr., S. W. West, and E. H. Cordes.
Geological Survey Open-file report, March 1970. 52 p, 11 fig, 12 tab, 7 ref. USAEC Contract No AT (29-2)-474. Rulison-5 Project.

Descriptors: *Hydrogeology, *Colorado, *Nuclear explosions, *Aquifers, Water levels, Water yield, Water pollution sources, Path of pollutants, Groundwater movement, Nuclear engineering, Nuclear wastes, Oil fields, Water wells, Permeability, Monitoring.
Identifiers: Gas fields, Project Rulison.

The Project Rulison nuclear experiment was detonated at a depth of 8,425 ft below ground level at the Rulison site in Garfield County, Colorado, September 10, 1969. The experiment was designed to stimulate natural gas production from a gas-bearing formation of low permeability. All zones below a depth of 6,129 ft in the Rulison exploratory hole that yielded any water during drilling, or zones interpreted from geophysical logs as being likely to contain water, were hydraulically tested. The pressures recorded during the drill-stem tests of the different zones indicated negligible or no fluid entry

to the hole. No fluid was recovered on any of the swab tests performed during the drill-stem tests. Studies of preshot and postshot hydrologic conditions indicate that the detonation did not significantly or permanently affect wells, springs, streams shallow aquifers, or reservoirs in or near the Rulison site. (Knapp-USGS)
W70-06517

09. MANPOWER, GRANTS AND FACILITIES

9A. Education (Extramural)

WATER FOR ARKANSAS,
Geological Survey, Little Rock, Ark.
R. I. Sniegocki, and M. S. Bedinger.
Geological Survey Cooperative Report, 1969. 46 p, 11 fig, 2 tab, 10 ref.

Descriptors: *Water resources, *Arkansas, *Social aspects, Schools (Education), Hydrogeology, Aquifer characteristics, Runoff, Geohydrologic units, Water quality, Water utilization, Streamflow, Water management (Applied), Public benefits, Reservoirs, Inter-agency cooperation.
Identifiers: Water knowledge (General).

To present Arkansas' water resources in a plain and interesting manner for the layman and for school children, this well-illustrated book was prepared from facts drawn from many published and unpublished reports and from suggestions and information given by the authors' associates in the U.S. Geological Survey. It avoids highly technical matters and yet gives much scientific information in an easy-to-understand manner. The book answers such questions about water as where it is, how good is it, how much is there, and how do we develop and manage it in accordance with the realities of nature. Block diagrams, maps, graphs, and photographs (many in color) are used extensively to show the geology, aquifer systems, range in well yields by aquifers, river systems, chemical quality of the different waters (streamflow and groundwater), depth to salt water, water temperatures, runoff by major river basins, large reservoirs, and water use in Arkansas by decades since 1900. A long range course of action is given stressing need for appraisal studies and the use of resulting facts in development of water plans and water management policies. A list of State and Federal agencies involved in Arkansas water resources is presented with their areas of competence and interest. (Lang-USGS)
W70-06576

9B. Education (In-House)

FINANCING WATER UTILITY TRAINING,
Mahoning Valley Sanitation District, Youngstown, Ohio.
For primary bibliographic entry see Field 06B.
W70-06414

OPERATOR TRAINING BY AN IN-PLANT APPRENTICESHIP PROGRAM,
Orange County Sanitation Districts, Fountain Valley, Calif.
For primary bibliographic entry see Field 05D.
W70-06626

9D. Grants, Contracts, and Research Act Allotments

GROUNDWATER RESEARCH IN THE U.S.A.,
Geological Survey, Washington, D.C. Water Resources Div.
For primary bibliographic entry see Field 06B.
W70-06402

10. SCIENTIFIC AND TECHNICAL INFORMATION

THE BIRTH AND DEVELOPMENT OF THE CONCEPT OF DIAGENESIS,
Strasbourg Univ. (France). Inst. of Geology.
G. Dunoyer de Segonzac.
Earth-Science Reviews, Vol 4, No 3, p 153-201, September 1968. 49 p, 1 fig, 4 tab, 157 ref.

Descriptors: *Diagenesis, *Reviews, *Bibliographies, Sedimentation, Water chemistry, Sedimentology, Groundwater movement, Clay minerals, Mineralogy.

The literature of diagenesis is surveyed and a selected bibliography is presented. The great number of researchers who are at present interested in diagenesis, and the increasing bibliographic exchanges between east and west have made necessary a detailed examination of the concept. Without a critical knowledge of the facts hidden behind the words, misunderstandings, if not quarrels, will soon make conversation between specialists difficult. In this article critical analysis is attempted without proposing any new system. (Knapp-USGS)
W70-06398

STATE-OF-THE-ART SURVEY SOIL STABILIZATION, VOLUME I,
Naval Air Engineering Center, Philadelphia, Pa. Engineering Dept.
For primary bibliographic entry see Field 08D.
W70-06463

REVIEW OF NEW GEOGRAPHIC METHODS AND TECHNIQUES. QUESTIONNAIRE SURVEY. WATER RESOURCE PLANNING AND MANAGEMENT. RECENT TRENDS IN REMOTE SENSING TECHNOLOGY,
Florida Atlantic Univ., Boca Raton. Dept. of Geography.
For primary bibliographic entry see Field 06B.
W70-06466

ANNOTATED BIBLIOGRAPHY OF RESOURCE USE, TEXAS GULF COAST,
Texas A and M Univ., College Station.
For primary bibliographic entry see Field 02L.
W70-06578

CHLOROPHYLLS,
Chicago Univ., Ill. Dept. of Botany.
For primary bibliographic entry see Field 02K.
W70-06661

WATER RESOURCES SYSTEMS ANALYSIS, PART I: ANNOTATED BIBLIOGRAPHY ON STOCHASTIC PROCESSES,
Illinois Univ., Urbana. Dept. of Civil Engineering.
For primary bibliographic entry see Field 06A.
W70-06698

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A. Center of Competence		
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University of Texas - Wastewater Treatment	W70 06579--06598 06600--06602 06604--06612 06614--06633	52
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B. State Water Resources Research Institutes		
Texas Water Resources Institute	W70 06315	1
Georgia Water Resources Center	W70 06316	1
New Jersey Water Resources Research Institute	W70 06447--06448	2
Montana Water Resources Research Center	W70 06702	1
Connecticut Institute of Water Resources	W70 06704	1
C. Other		
General Electric-Tempo	W70 06705--06706	2

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